POWER

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The Engineer's Future

The operating engineer is constantly faced with the admonition "Learn more to earn more." Looking at matters from the engineer's standpoint, we might well ask the question "What shall we learn?" The adviser promptly answers "More about your work as an engineer." We then answer "Our knowledge of engineering has increased, as is proved by the list of plants from which we hold endorsements showing that we have competently operated different types of engines, many types of boilers and electric equipments. We are now in charge of the same work that we took hold of at the beginning, only in larger proportion—in a larger plant, but still responsible for the operation. We are confined to exacting hours of duty—expected to give attention to extra work at all times if necessity requires it—usually without extra pay. Vacations are not known because there must be no loss of time due to an inoperative plant.

"Our progress is represented only in the difference in the amount of responsibility. Therefore, 'What shall we learn?' "

When we first enter as the oiler or fireman in the power plant our constant aim is the higher position occupied by our superiors. When we ultimately reach this position, are we then to stop and be content?—But the preceptor answers "Learn more." The public, therefore, puts itself in a very peculiar position. It lays down advice for the operating engineer, but utterly fails to clarify the situation, so that the engineer may intelligently be benefited. No one would suggest to the engineer that his studies be along different lines, such as languages or chemistry. We must then ask ourselves is there any truth in the public's statement, and if so, where does it apply? To this point I will attempt an answer:

If the engineer is in a place wherein he is congenially situated, would it not be logical for him to pay specific and careful attention to the details of the business for which he is daily producing power, and thus be in a position to not only protect power production but to co-operate with its actual management and thus prove himself capable of handling more than one special line of work? An engineer who has already established by service that he is capable and to be depended upon should be able to build on such a platform a further step of progress by learning the details of the business, and there are many plants where it is has been my pleasure to find that as the years progressed the engineer progressed, ultimately leaving the details of his engine room to men whom he could rely upon under his general direction, whereas he became the superintendent of the whole plant and thus had reached the goal wherein he could secure for himself the time to take a vacation by having organized the departments under capable subordinates who could carry the details for a period during his absence, and enable him to enjoy the results which hard work should have wrought.

Another line of study: Let the engineer become so conversant with the details of the equipment that he is operating that he is an authority as to its efficiency. His opening then is to work for the manufacturer of those particular machines, be they engines, motors or any kind of operating machinery, and by his knowledge secure that remuneration so long sought for. I think both of these outlets are the two logical broad avenues over which an engineer should ultimately hope to travel, selecting the one to which he is most adapted. Those of us who have had the pleasure of dealing with the engineering salesman who thoroughly knew the subject which he was representing—who could tell us clearly and quickly the things we wished to know, and which we would be most likely to ask, without making us do the cross-examining—have placed our confidence with the man who knew. Who should be better qualified to know than a man who has had the training with the actual operation of machinery?

Engineering salesmen should be capable operating engineers in these days of modern economy. Who should be more competent to keep down operating costs or ably represent operating equipment than the man who not only knows every detail of manufacture, but understands all the details of the power plant and its requirements?

[*Written by Charles H. Parsons, New York City.*]

Reid, Murdoch's New Plant

By Thomas Wilson

SYNOPSIS—A 400-kw. electrical plant supplying exhaust steam for heating and refrigeration. In average winter weather the supply and demand for exhaust steam balance, and in summer there is not enough exhaust steam in excess to warrant a condensing installation.

One of the most convenient and uptodate buildings for the wholesale-grocery trade has just been erected by Reid, Murdoch & Co., of Chicago. It has a river frontage of 325 ft. and the main portion extends back 200 ft. to North Water St. East and west the building is bounded by Clark and La Salle Sts. With its nine stories of brown brick and a tower containing clocks with 15-ft. dials, it is attractive, and might well serve as an example to others

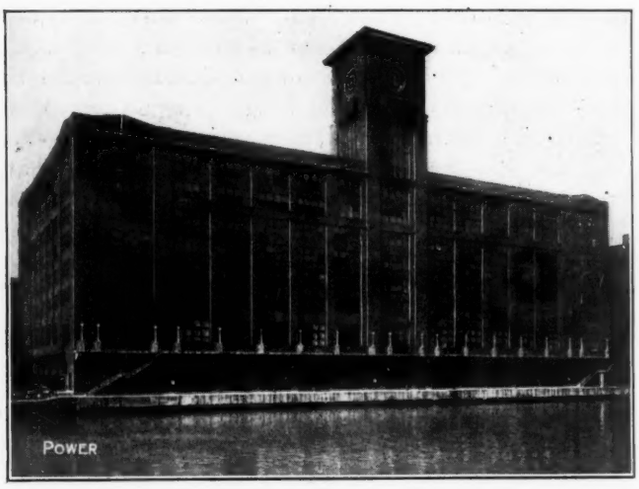


Fig. 1. Reid, Murdoch's New Warehouse

who wish to conform to Chicago's latest slogan, "Beautify the river."

For shipping and receiving, the building has both water and rail facilities. The sub-basement is somewhat below the dock level and the basement is above at the level of a freight-car floor, with the cars at the North Water St. grade. All shipping is done from the basement. Two railroad tracks occupy the north portion, the entire west face is given over to wagon shipments, and the south side to transportation by water.

For handling freight there are four electric elevators of the winding-drum type, with provision for a fifth, and one traction passenger machine, with room provided for a second. Motors of 40 and 30 hp., respectively, with the accompanying apparatus were installed in penthouses over the shafts by the Pitt Engineering Co. In addition to the elevators, there are one double- and one single-spiral chute extending the full height of the building and a power conveyor with a system of secondary gravity conveyors designed to receive freight in carlots and deliver it to various locations on the warehouse floors without handling any package from the time it is lifted in the car.

Although the building is mainly warehouse, on the upper floors there is some machinery, including a complete coffee-roasting plant, labeling and dried-fruit rooms, baking-powder department, etc. All of the machinery is operated electrically, and in general Crocker-Wheeler motors are used. There are about 40, these for the most part being 5- and 10-hp. machines with a few 15-hp. motors on the large ventilating fans. For illumination, the electrical installation is unusually complete, including direct lighting for the entire warehouse and indirect lighting in the offices. The stairs, halls and fire escapes are from independent circuits which may be controlled from the engine room. For heating, 30,000 sq.ft. of direct radiation has been installed and for ventilation 3000 sq.ft. of "Vento" radiation in connection with the fans which, in effect, is equivalent to 9000 sq.ft. of direct surface. There is also a 40-ton Carbondale absorption refrigerating plant, although the present requirements will not call for much more than three-quarters of the rated capacity.

To fulfill these various demands an uptodate private plant was installed. Five hundred horsepower in boilers serve two 200-kw. generating units made up of a 17x22-in. Ball four-valve engine connected directly to a Crocker-Wheeler three-wire, 110-220-volt generator running at 200 r.p.m. Exhaust steam from these engines is supplied to the heating system and to the absorption refrigerating plant. Although the plant is on the river, a condenser was not provided, as there is little exhaust steam in excess of the heating and refrigerating demands.

During April the load on the generating units averaged 1600 to 1800 kw.-hr. per day of 11 hr. With a uniform load this would call for a generator capacity of 164 kw., but fluctuations gave peaks of over 200 kw. In the winter months the load will probably exceed the April demand, and run close to 200 kw., or 24,200 kw.-hr. per day. The guarantee on the engine was 22 lb. per indicated horsepower-hour, so that in operation the rate should average about 35 lb. per kw.-hr. On the maximum winter load there would be available per hour

$$200 \times 35 = 7000 \text{ lb.}$$

of exhaust steam, whereas in zero weather the heating and ventilating systems would require

$$(30{,}000 + 9000) \times 0.3 = 11{,}700 \text{ lb.}$$

There are only a few days of zero weather during the season, so that but little live steam will be required for heating except at night, when the engines are not running. Ordinarily, the heating demand will not be much more than half of the above figure, and there will be plenty of exhaust steam in addition to furnish whatever refrigeration is needed during the heating season. In the five warmer months the refrigeration will run about 30 tons. With cooling water at 70 deg. F. and exhaust steam at ½ lb. pressure, each ton will require 35 lb. of steam, or a total of 1050 lb. per hour. The electrical load will probably be somewhat lighter than in April and it may not exceed 150 kw. With a uniform load, there would be available about

$$150 \times 35 = 5250 \text{ lb.}$$

of exhaust steam per hour from the main units to help the auxiliaries supply the refrigerating system and to heat the water for boiler feed and house purposes. Not more than 3000 lb. per hour would be exhausted to atmosphere, and for 130 days of 11 hr. the total would be

4,290,000 lb. At 20c. per 1000 lb., this quantity might be valued at $858.

A condenser in an installation of this size would not increase the efficiency more than 20 per cent., so that the annual saving thus effected would not exceed $171, which would limit the investment to $1368, figuring 12½ per cent. for interest and depreciation. If the refrigerating load increases to rating, as is expected in time, or if steam is produced for less than 20c., the margin would be still smaller, so that a condenser would not save enough to pay the usual interest and depreciation on the investment, not to mention the complication of the piping and the additional equipment that would be needed With a condenser it would be necessary at times to use live steam for the refrigerating plant; this would tend to counteract any advantage from the former.

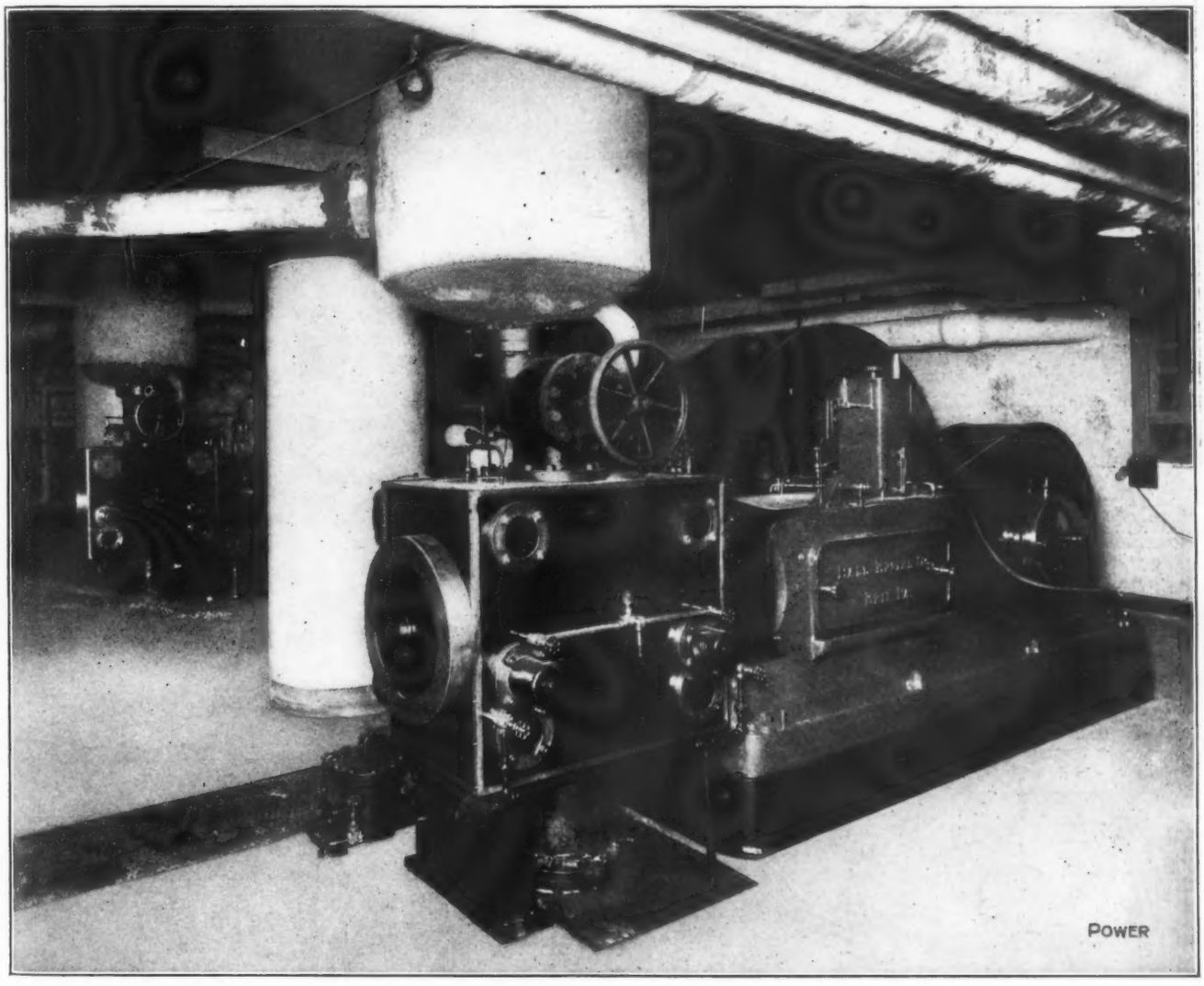


FIG. 2. THE 200-KW. GENERATING UNITS

BOILER ROOM

There are two boilers and provision is made for a third, of the B. & W. steel-header type, horizontally baffled, and each containing 2500 sq.ft. of heating surface. They are equipped with Green chain grates, 5 ft. wide and 9 ft. long, having an effective area of 42.9 sq.ft. A lined, steel breeching with a uniform section of 4½x6 ft. serves the two boilers; the lined steel stack rises 165 ft. above the boiler-room floor, and 30 in. less above the grates. It is 5 ft. in diameter and on the stack side of the damper produces a draft of 0.87 in. of water. Over the fire the draft reduces to 0.4 in. The ratio of heating to effective grate surface is 58 to 1. The sectional area of the breeching bears a ratio to the connected grate surface of 1 to 3.18, and to the stack area a ratio of 1 to 0.73. For every square foot of sectional area in the stack there is 4.37 sq.ft. of grate.

The working pressure is 125 lb. gage, although the safety valve is set to pop at 140 lb. Each boiler is equipped with Vulcan soot cleaners. The usual dusting doors have been omitted and the entire boiler setting has been made air-tight by means of 2-in. "Vitrobestos" covering outside of the brickwork.

One feature is a system of galleries. On the main gallery is a Cochrane open heater with a recording V-notch meter. On the front of the boilers is mounted a washout gallery from which the front-tube caps are accessible. The gallery structure also supports the stoker shaft, which is belt driven by either a motor or a small vertical engine mounted on the main gallery. The main header, which is 6 in. in diameter, is approximately 4 ft. from the ceil-

ing, and is accessible from an upper gallery so arranged that all important valves are within reach.

Another feature is an Eclipse smoke indicator designed by T. W. McNeill, chief engineer of the plant. It has an incandescent lamp with an X-ray reflector mounted in a sleeve on the rear side of the breeching. The light shines through the breeching and a glass-faced sleeve mounted opposite a sight box visible from the front of the boilers. In this box the light strikes a 45-deg. mirror and is reflected at right angles onto a ground-glass screen. When smoke passes through the breeching it cuts off the light, and the density of the smoke may be gaged by the color of the screen. With no smoke it is white, with dense smoke it is black, and with various densities of smoke the screen is shaded accordingly. It is thus possible for the fireman to observe the immediate effect of his work, and by continued observation he can learn how to avoid making smoke.

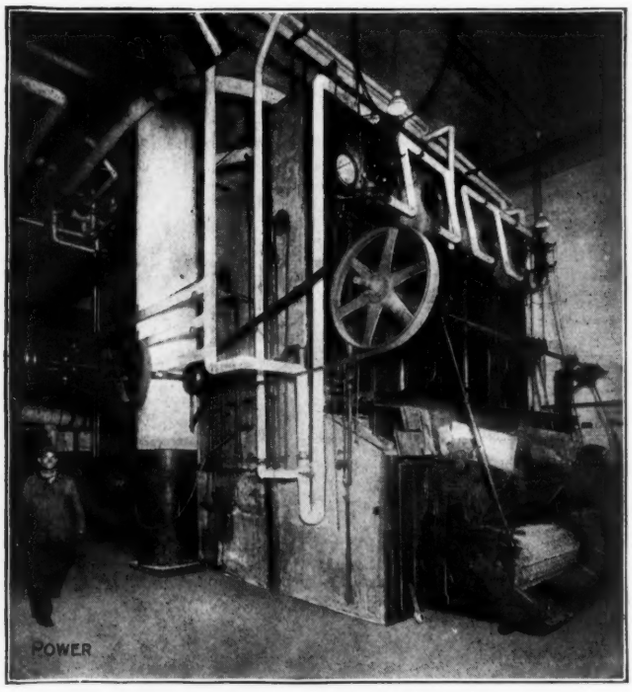


FIG. 3. BOILER-ROOM EQUIPMENT

In front of the boilers there is storage for 450 tons of coal, which is received from the railroad cars above and, after being weighed, is shoveled into the stokers. The ashes are discharged directly from the ashpits into a shaft leading to the Illinois tunnel, which is Chicago's underground subway for handling freight. Water for feed purposes comes from the heating system in winter and the makeup from the city mains. At 210 deg. it flows from the heater to either one of two 8 and 5 by 12-in. Warren pumps and is forced to the boilers. A venturi meter measures the supply and checks the results obtained by the Lea recorder in the heater; the pumps are piped to supply the 60,000-gal. tank of the sprinkler system in the tower. The pumps are at one end of the engine room, where are grouped an Alberger 3-in. turbine-driven house pump, an Alberger 3-in. brine pump, a Warren 7½x10-in. direct-acting brine pump, a Westinghouse air pump for the sprinkler system and two American 8 and 12 by 12-in. vacuum pumps used on the heating system.

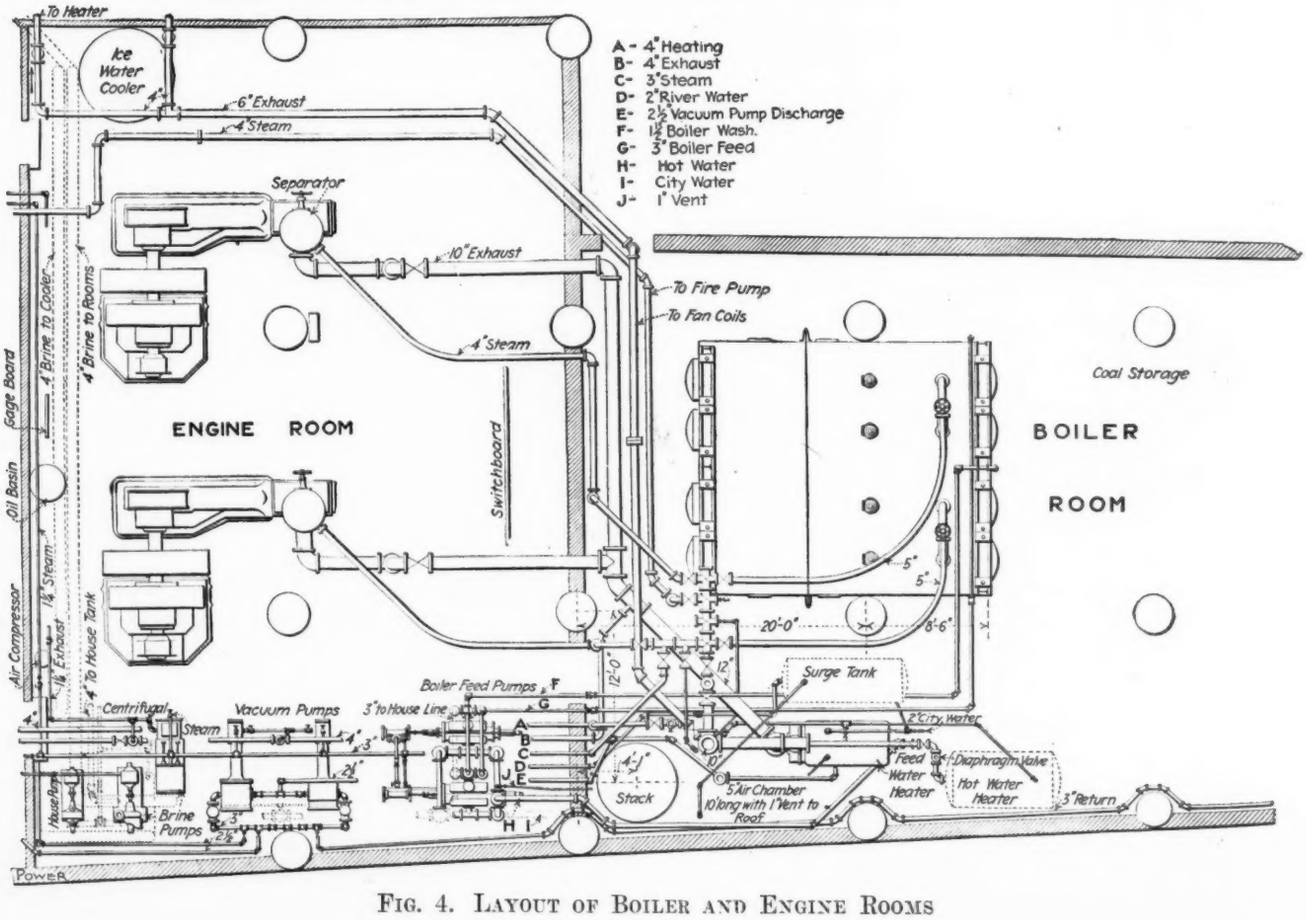


FIG. 4. LAYOUT OF BOILER AND ENGINE ROOMS

The size of the generating units has been previously given as 200-kw. Each engine is supplied with steam by a 4-in. pipe which leads into a large separator drained to the heater. This diameter gives a sectional area of 0.0636 sq.in. per kilowatt of rating and an average velocity for the steam of 4200 ft. per min. The exhaust pipe, which is 10 in. in diameter, has on the same basis 0.3943 sq.in. and an average velocity of 5700 ft. The two exhausts unite into a common 12-in. pipe running to the oil separator of the heater. From this point a 10-in pipe supplies the heating system and a 4-in. tap from it feeds the hot-water tank. Provision is also made to supply the heating system with live steam, and a 4-in. branch tapped from the 12-in. exhaust pipe supplies the refrigerating system with steam. This pipe is also fed with the exhaust from the steam pumps.

The switchboard, which has five panels, is equipped with Weston ammeters and voltmeters and four Duncan watt-hour meters, one for power, one for the lighting, one for the elevators, and a totaling meter which records the output. For the motors the voltage is 220 and for the lights 110. For emergency night lighting there is an Edison throw-over switch.

A gage board in the engine room is well supplied with instruments to indicate the various pressures in the plant. There are gages for high-pressure steam, city water, river water, sprinkler system, brine and air; combination pressure-vacuum gages for the heating system and house returns; combination pressure and temperature gages for the generator and cooler of the refrigerating system, a

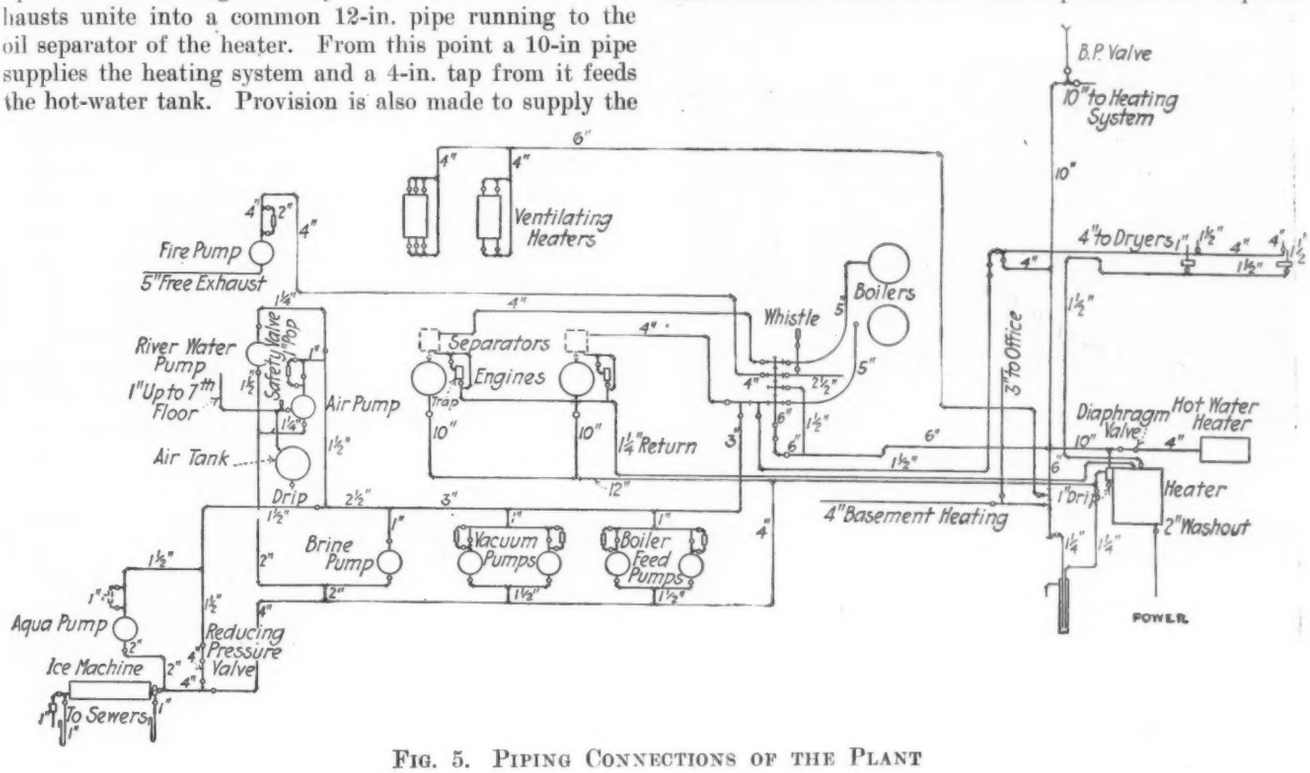


FIG. 5. PIPING CONNECTIONS OF THE PLANT

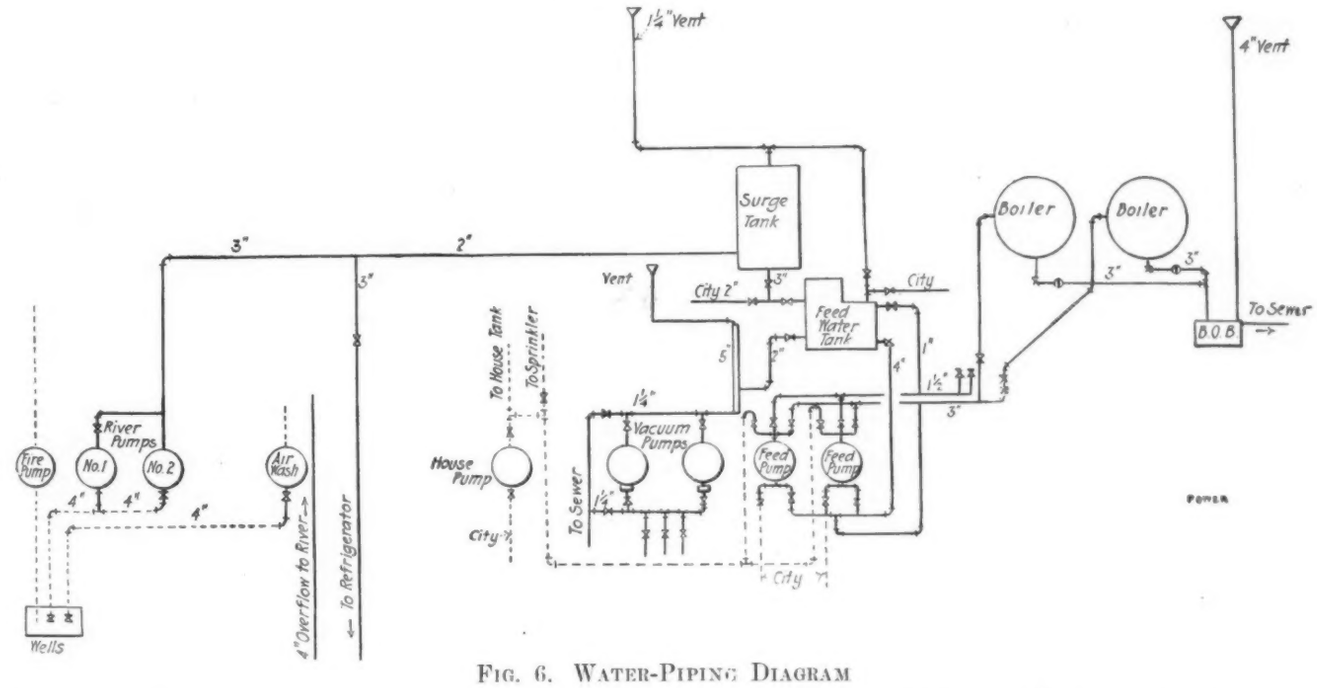


FIG. 6. WATER-PIPING DIAGRAM

gage to indicate the head in the house tank, a recording steam-pressure gage and an eight-day clock.

Heating and Ventilation

To heat the building in zero weather requires 30,000 sq.ft. of direct radiation, which in general is in radiators hung on the walls and supplied from down-feed piping; each radiator is equipped with Illinois vacuum valves. The returns are run to the vacuum pumps and by them are fed to the Cochrane heater. On the first floor, which is mainly offices and salesrooms, the direct radiation is supplemented by a ventilating system. A shaft from the roof to the sub-basement furnishes the supply of fresh air. The air is led into the fan room adjoining the engine room where it encounters a set of heating coils, a Webster air washer and a set of reheating coils; this washer is equipped with sheet-zinc eliminator plates to prevent corrosion.

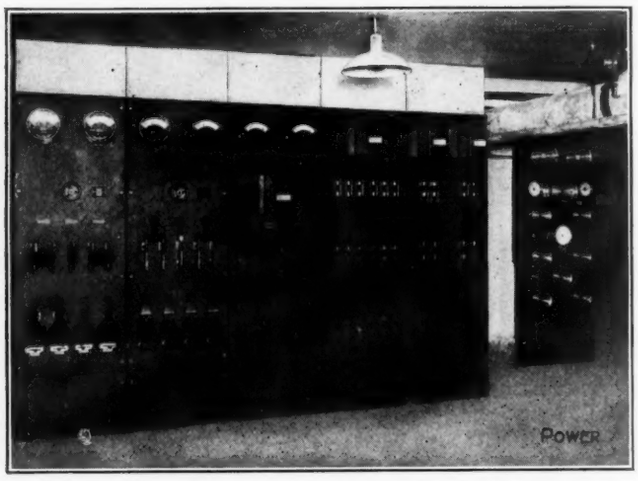


Fig. 7. Switchboard and Gage Panel

Provision has been made for humidity control, and it is intended to supply the air at 90 deg. in winter with the humidity averaging close to 65 per cent. Two motor-driven fans handle the treated air; one 60 in. in diameter supplies 30,000 cu.ft. per min. to the offices. This is based on about six air changes per hour. The smaller fan supplies 10,000 cu.ft. from the humidifier without reheating to the engine and boiler rooms in the sub-basement. Foul air from the offices is collected in a second system of ducts and is discharged at the second floor by the main exhaust fan, which is in the sub-basement. With this system in operation the office floor is independent of

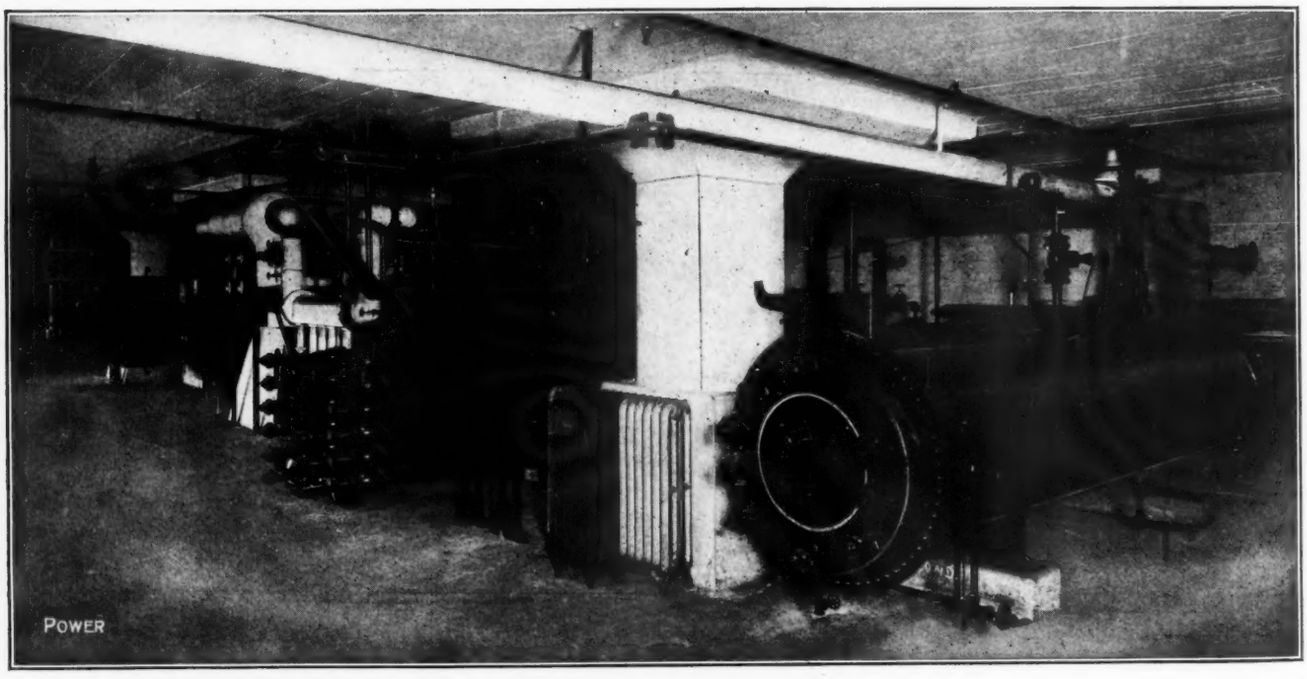


Fig. 8. Forty-Ton Absorption Plant

PRINCIPAL EQUIPMENT OF REID, MURDOCH & CO'S POWER PLANT

No.	Equipment	Kind	Size	Use	Operating Conditions	Maker
2	Boilers	Water-tube	250 hp.	Steam generators	125 lb. gage, stokers	Babcock & Wilcox Co.
2	Stokers	Chain-grate	42.5 sq.ft.	Boiler furnace	Mechanical	Green Engineering Co.
1	Heater	Open		Heating boiler feed water	Metering heater, temperature 210 deg.	Harrison Safety Boiler Works
2	Engines	Four-valve	17x22 in.	Main units	200 r.p.m., 125 lb. initial, ½ lb. back pressure	Ball Engine Co.
2	Generators	Direct-current	200 kw.	Main units	Three-wire, 110-220-volt	Crocker-Wheeler Co.
4	Elevators	Electric		Freight		Pitt Engineering Co.
1	Elevator	Geared tractions		Passenger		Pitt Engineering Co.
1	Refrigerat'g system	Absorption	40 ton	Cooling storage rooms	Exhaust steam ½ lb. press.	Carbondale Machine Co.
2	Pumps	Single-cylinder	8x5x12 in.	Feed to boilers	125 lb. press., water supplied under head	Warren Steam Pump Co.
1	Pump	Centrifugal	3-in. suction	House pump	Motor-driven, 2400 r.p.m.	Alberger Pump & Condenser Co.
1	Pump	Centrifugal	3-in. suction	Brine pump	Motor-driven	Alberger Pump & Condenser Co.
1	Pump	Duplex	7½x10-in.	Brine pump	125 lb. pressure	Warren Steam Pump Co.
2	Pumps	Single-cylinder	8x12x12	Vacuum pumps	125 lb. pressure	American Steam Pump Co.
1	Pump	Duplex	7½x6x10	Water to refrigerating condenser	125 lb. pressure	Henry R. Worthington
1	Pump	Centrifugal	3-in. suction	Water to refrigerating condenser	Motor driven	Alberger Pump & Condenser Co.
1	Pump	Double-acting	10x4½	Aqua pump	Power driven	Carbondale Machine Co.
1	Pump	Single-cylinder	10x4½x12	Aqua pump	125 lb. pressure	Carbondale Machine Co.
1	Pump	Duplex	18x10x12	For fire	125 lb. pressure	Fairbanks, Morse & Co.

Warren Webster air washing apparatus, American Blower Co. fans, Power's System of humidity control.

any window ventilation and the windows are permanently fixed. A small independent exhaust system removes air from the first-floor toilets.

Refrigerating System

This is a standard 40-ton Carbondale plant using exhaust steam at ½ lb. pressure to refrigerate the storage rooms in the sub-basement, and the fifth and sixth floors. There are a dried-fruit room, 60x120x11 ft. high, to be maintained at 40 deg.; a fish room, 60x80x11 ft., at 26 deg.; a cheese room, 60x12x11 ft., at 32 deg.; a nut box, which is cooled slightly, and a drinking-water cooling system with a centrifugal circulating pump. The rooms are constructed entirely of block cork and finished with cement plaster. The brine piping is insulated with Nonpareil cork. About 12,000 gal. of brine is circulated per hour; its temperature loss is to be 5 deg. The brine pipe in the refrigerating rooms is 1 in. in diameter, and there is a total of 18,600 lin.ft.

The plant has both steam and motor-driven aqua and brine pumps. The condenser, which is of the shell type and contains 1000 sq.ft. of surface, is supplied with river water by either a Worthington duplex steam or an Alberger motor-driven centrifugal pump, the former being for night service. There is an intake well in the dock to which are connected the two circulating and a 1000-gal. Fairbanks-Morse fire pump.

W. L. Fergus, consulting engineer, and T. W. McNeill, chief engineer of Reid, Murdoch & Co., are responsible for the layout and installation of the plant.

Will Quizz, Jr.

Dear Chief:

Since you have been away on your vacation I have been reading some, but I must write and ask questions: In the booklet entitled, "Valve Setting," which I received with my subscription to Power, I notice it says that in making a half stroke of the piston the crank does not quite reach the perpendicular in a horizontal engine. Now, it does not go any farther in the explanation.

If the piston is past halfway of the stroke when the crank is at the quarter, what would prevent the piston striking the cylinder head before the crank got to the center? When the piston is in the center of its travel and the crank has not yet reached a quarter of its travel, how is the crank to gain twice the distance which it lacks from the perpendicular before it reaches the other center or before the piston finishes its travel? If you can explain this, I wish you would. I can't find a solution of it in any of my books.

Hoping to hear from you soon, I am

Respectfully yours,

Will Quizz, Jr.

Dear Will:

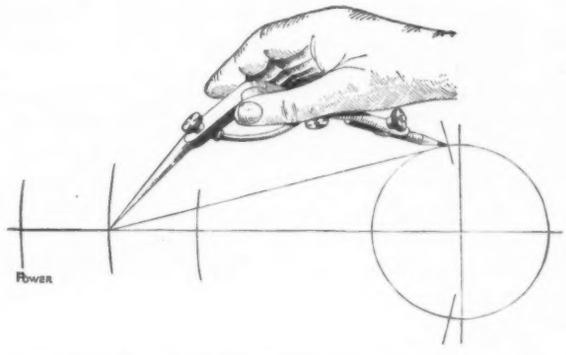
I am glad to note that you have been delving into your new booklet. "Valve Setting" does not enter into the discussion of the question you asked at length, because it is a book of instruction on setting valves of various kinds. It could not properly digress to discuss other subjects, even though closely related.

This question, like a great many other similar ones, either has been or must be learned by every enterprising young engineer at some time, and I am glad you asked it. Take that pair of dividers which has a pencil on one side (the two sides will be referred to as point and pencil) and do just as follows, and you will have the whole story.

First draw a horizontal and across it a vertical line. Set the dividers 2 in., and place the steel point where the lines intersect, and with the pencil describe a circle which will be 4 in. in diameter. Let this represent the crank circle. Now set your dividers 8 in., and do not change it as it now represents the length of a connecting-rod which in this case is twice the length of the stroke.

Place the point on the horizontal line at the left where the circle crosses it and make a short mark on the line with the pencil. This we will call the end of the travel of the crosshead pin toward the cylinder. Now make a similar mark on the horizontal line, using the opposite side of the circle. This will represent the end of the pin travel toward the crank. Now we have the equivalent of the crosshead travel (4 in.) which is identical with the piston travel.

From the center of the circle make a third mark which will be midway between these two points of travel. Then with the point on this last mark make a mark on the



Why the Piston Reaches Center First

upper side of the circle and also one on the lower side, which you will find fall short of the vertical line.

Since you see the slant distance is greater than the horizontal and the connecting-rod does not lengthen, then, of course, when the crankpin has reached the vertical line the crosshead must have traveled beyond the mid position. With a constant speed of rotation the piston travels faster on the first and fourth quarters of the revolution than on the second and third. In other words, it travels further in a given time.

The handy old rule 6, 8 and 10 for getting two lines at right angles to one another will clear this up for you. Take a carpenter's square and measure across from the 8-in. mark on one side to the 6-in. mark on the other, you will find the distance is 10 in. These distances are referred to simply, because they are easy to remember and to verify. Any others may be used, but do not always give the result in even numbers. The rule is that when the horizontal distance is multiplied by itself ($8 \times 8 =$

64) and the vertical also multiplied by itself ($6 \times 6 = 36$) and these two added together ($64 + 36 = 100$) the sum will equal the slant distance multiplied by itself ($10 \times 10 = 100$), as you can see it does.

This rule will work out the same way for a right-angle triangle of any proportion. Now, Will, don't get alarmed, this is no balloon trip. The square of the base plus the square of the perpendicular equals the square of the hypotenuse. It, therefore, follows that if any two distances are known the other may be obtained. For instance, if you have the hypotenuse (10) and the base (8), the square of the other will be the difference between the squares of these two, so $10 \times 10 = 100$, $8 \times 8 = 64$, $100 - 64 = 36$, which is the square of some number (which means it is equal to some number multiplied by itself), which in this case you can easily see is $6 \times 6 = 36$. How to get the results by square root can be easily shown. If you want more of this at a later date, all you have to do is to write and ask for it. This will be all this time.

Your old chief,

TELLER.

Laying Out a Breeching and Stack*

By Osborn Monnett†

SYNOPSIS—Methods of obtaining dimensions applied to a plant having five water-tube boilers.

To illustrate the methods given in previous articles, a set of calculations to determine the dimensions of a direct-connected breeching and stack will be carried out for a plant containing five 410-hp. water-tube boilers equipped with the conventional vertical baffling and chain grates. A sectional view through one of the boiler settings is shown in Fig. 1, and Fig. 2 gives full dimensions for the breeching and stack.

The heating surface per boiler is 4100 sq.ft. and at a ratio of 50 to 1 the grate surface would be 82 sq.ft. The nearest commercial size of grate to give this surface is 9x9 ft., or 81 sq.ft. of actual area.

With ordinary Western bituminous coal it has been found that 5 lb. of coal per boiler horsepower is a good figure upon which to base calculations, and a good average evaporation for this kind of coal is 6.9 lb. of water from and at 212 deg. F.

The plant will be laid out on the basis of 50 per cent. overload, or an output of 615 hp. per boiler. This means that each grate must burn 3075 lb. of coal per hour or a maximum of

$$\frac{3075}{81} = 38 \; lb.$$

per square foot of grate surface per hour. According to the curve shown on page 808 of the June 9, 1914 issue, it will require a draft of 0.46 in. over the fire to burn the 38 lb. of coal per square foot of grate surface per hour. On the basis of 24 lb. of flue gases per pound of coal, burning 3075 lb. of coal will produce

$$24 \times 3075 = 73{,}800 \; lb.$$

of gas per hour.

To find the velocity of the gases and the proper size of breeching the volume of the above weight of gas at the temperature in the flue must be determined. For convenience the weight of 1 cu.ft. of air at different temperatures is given in Table 1, and as the difference in density between air and flue gases is so slight as to be negligible in practice, the values in the table will be used in the present design.

TABLE 1. WEIGHT OF 1 CU.FT. OF AIR AT DIFFERENT TEMPERATURES

Deg. F.	Lb.	Deg. F.	Lb.
400	0.046223	525	0.040364
425	0.04492	550	0.039365
450	0.043686	575	0.038415
475	0.04252	600	0.03751
500	0.041414		

Assume that the temperature of the gases at the boiler uptake is 500 deg. F. The weight of a cubic foot of gas at 500 deg. is 0.0414 lb. Therefore, the volume of 73,800 lb. of gas at a temperature of 500 deg. is

$$\frac{73{,}800}{0.0414} = 1{,}782{,}608 \; cu.ft.$$

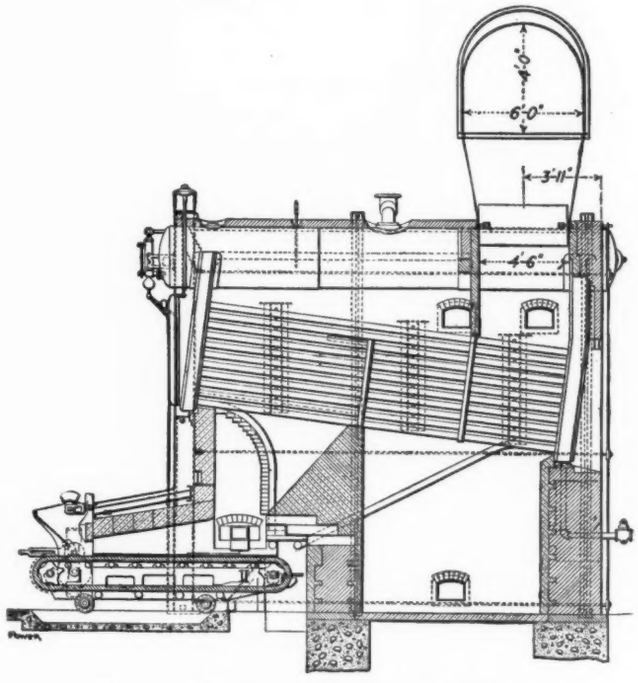


FIG. 1. TYPE OF SETTING EMPLOYED

This is the flow per hour and per second it would be

$$\frac{1{,}782{,}608}{3600} = 495 \; cu.ft.$$

At 50 per cent. overload, the velocity in the breeching should not be more than 28 ft. per sec., and at this velocity the area of the breeching per boiler will be

$$\frac{495}{28} = 17.67 \; sq.ft.$$

For five boilers this gives an area at the stack of

$$5 \times 17.67 = 88.35 \; sq.ft.$$

The total connected grate surface is

$$81 \times 5 = 405 \; sq.ft.$$

*Copyright, 1914, by Osborn Monnett.
†Smoke inspector, city of Chicago.

so that the ratio of breeching area to total grate surface is 88.35 to 405, or nearly 1 to 4.5.

Area of Stack

A velocity of 30 ft. per sec. in the stack at 50 per cent. overload would give an area of

$$\frac{495}{30} = 16.5 \; sq.ft.$$

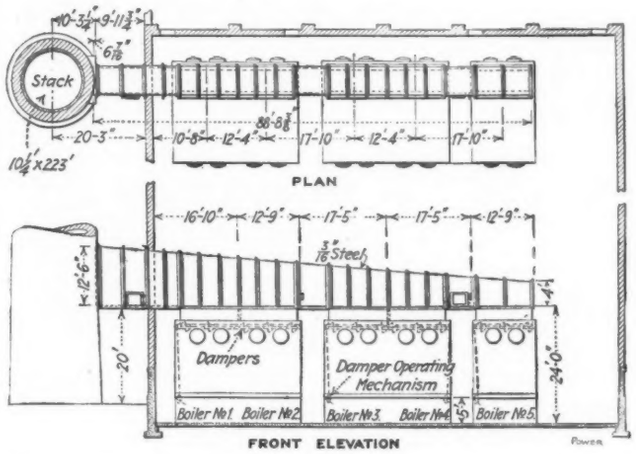


Fig. 2. Layout of Breeching of the Five Boilers

per boiler, or 82.5 sq.ft. as the total area of the stack. This calls for a diameter of 10.25 ft. and a ratio of stack area to connected grate surface of approximately 1 to 5.

Height of Stack

In finding the height of stack it is necessary to make an analysis of the boiler setting, dampers, uptake and breeching connections to arrive at the loss of draft occasioned by the design selected. Starting with the grate surface, a draft of 0.46 in. will be required over the fire. Referring to Fig. 4 on page 768 of the June 2, 1914 issue, it will be noticed that the loss of draft for this type of setting is 50 per cent., indicating that there must be 0.92 in. of draft at the stack side of the damper on the boiler farthest from the stack. From this point there is a run of 88 ft. to the stack, and for ordinary practice the drop through this length of breeching can be taken as approximately 0.2 in. Besides, there are four other boilers connected into the breeching which interpose an additional draft loss of

$$4 \times 0.05 = 0.2 \; in.$$

making a total draft loss in the breeching of 0.4 in. and necessitating a draft at the stack of

$$0.92 + 0.4 = 1.32 \; in. \; of \; water$$

The temperature at the stack will be approximately 475 deg., and the problem is to determine for this temperature the height of stack which will provide 1.32 in. of draft where the breeching enters the stack. Interpolating between the constants for 450 and 500 deg. given in the table on page 809, June 9 issue, a constant of 0.0065 is obtained for 475 deg. Then

$$\frac{1.32}{0.0065} = 203 \; ft.$$

will be the theoretical height of stack required. Ordinarily, this is taken to indicate the height of the stack above the ground level. However, no stack or breeching layout gives the theoretical draft. There is always loss due to skin friction, leakage, etc. These losses are usually taken into consideration by using some empirical formula based on a number of assumptions. It is simpler in this case to assume that the height of 203 ft. is the height of the stack above the breeching connection, and as this is 20 ft. above the ground level, the total height of the stack will be

$$203 + 20 = 223 \; ft.$$

This automatically furnishes a correction for friction, leakage, etc., without the use of any empirical formula and gives leeway to compensate for unexpected draft losses.

The above design will care for heavy fluctuations of load on individual boilers. One or more boilers will generally be down for cleaning or repairs, but with the liberal gas passes provided, the remaining boilers can easily be run above the designed 50 per cent. overload without trouble. In a plant erected according to these figures and now running successfully, the last boiler in the line has easily carried at intervals over 200 per cent. of rating.

A Carnegie Tech. 750-Hp. Stumpf Engine

When the plans were prepared for additions to Machinery Hall, the Woman's School, the Applied Design Building and the Administration Building of the Carnegie Institute of Technology, bids were asked from three engine builders for a direct-flow engine, which type was invented by J. Stumpf, professor of steam engineering at the Royal Institute of Technology, at Charlottenberg, Berlin, Germany. The bid accepted was that of the Mesta Machine Co., which guaranteed a steam consumption of 27 lb. per kilowatt-hour.

The engine was delivered early in 1913. It is equipped with the type of valve-gear regularly built by the Mesta Co., but worked unsatisfactorily when started up. The *Tartan* of the institute states the cause as follows:

> On account of the short cut-off with which the direct-flow type of engine regularly works, the pressure disappears so quickly in the cylinder that the valve becomes unbalanced before the force of the vacuum pot has time to move it through its travel. This results in the valve gearing striking hard blows against the parts connected with the valve. Larger and more effective vacuum pots were installed, but after the engine had furnished power for the exhibition night of the school it was found that the piston had worn itself and the cylinder considerably. Careful study of the condition showed that the piston as originally designed was unbalanced. To overcome this trouble a new type of piston and a new cylinder bushing were made.
>
> A new and stronger rear cylinder head was also furnished to make doubly sure that no injurious deformation could occur in the valve seats.
>
> Nothing was done toward starting the engine during the summer, for the steam plant of Carnegie Tech is regularly shut down during the summer months. When the steam plant started up again in October there was not load enough to test out the engine to its capacity. It was not until Christmas that a rheostat was provided for loading the engine, the work of placing the rheostat in commission being done by an erector of the builders of the engine. While the engine furnished power for the schools during November and December, it was quite noisy, and it developed that the quick passing of the piston over the exhaust ports slammed the valves against their seats. Shoes were then provided which hold the valves on their seats continuously.
>
> In December the Mesta Machine Co. requested the Carnegie Institute to run the engine regularly. It was arranged that as a matter of precaution the interior of the cylinder should be inspected before the engineers of the Institute would undertake operation of the engine. To the surprise of everybody it was found that the cylinder had been slightly cut, due to steam blowing through a split in the piston rings for which no brass keeper had been provided, on the basis

that brass is not a suitable material for use with superheated steam. Hence it was necessary to make and install the so called Duquesne type of piston ring, which is perfectly sealed and prevents leakage of steam without a keeper.

Since early in January the engine has been in regular operation on the school load practically every day, picking up the load at about 10:30 in the morning and carrying it until 10 at night. From 7 until 10:30 in the morning and from 10 until closing time at night the light load is carried by a smaller engine.

A test which was run on the Mesta engine indicated that the steam consumption is below the guarantee—that is to say, less than 27 lb. per kw.-hr., so that the steam economy is better than the guarantee called for.

Carnegie Tech is the first technical institution in the world to have an engine of the direct-flow type. The troubles which attended the early operation of the engine were not wholly unexpected, since any departure from existing practice, in spite of most careful study, usually requires some experimenting.

The Mesta Co. is at work designing a poppet valve-gear for this engine which will be thoroughly tested out before any change is made. Furthermore, there is no necessity for haste as the engine carries its load economically right along with the Corliss type of valve-gear.

Automatic-Cutoff Engines

By Alfred Butcher

Most engineers are interested in high-speed, automatic-cutoff engines, and wish to learn more about them, especially the governing device. To begin with, we will go back to the ordinary slide-valve engine with the throttling governor and observe the difference in the two types of governing mechanism, their speed in action and economy. With 100 lb. pressure on a throttling engine, the governor would regulate the pressure of steam admitted to the cylinder with a constant cutoff. It can be seen that steam has been raised to that pressure, but utilized at a lower pressure, as determined by the governor according to the load.

The most important item is the expansion of the steam. The gain by expansion consists in the admission of steam at boiler pressure much above the average pressure required to do the work. An early cutoff, then, allows it to expand to a lower pressure toward the end of the stroke. The reason steam is so valuable to us is because of its expansive power.

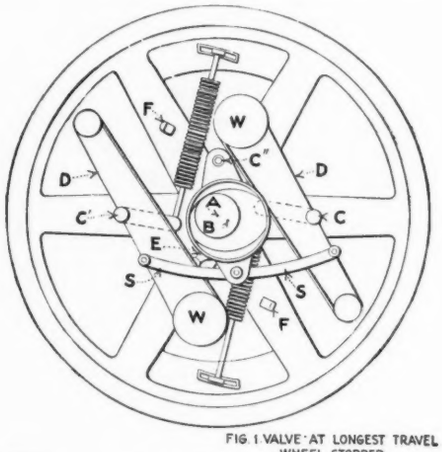


FIG. 1 VALVE AT LONGEST TRAVEL WHEEL STOPPED.

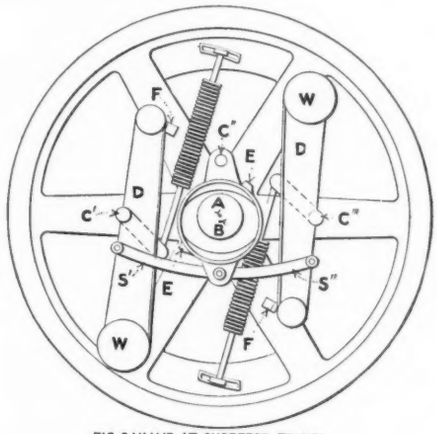
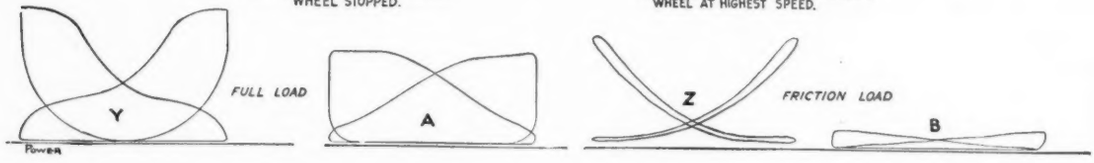


FIG. 2 VALVE AT SHORTEST TRAVEL, WHEEL AT HIGHEST SPEED.



Comparison of Fixed and Variable Cutoff

The diagrams A and B are drawn to make these statements clearly understood, where the height of the diagrams represents the pressure. The throttling-engine valve cuts off at the same part of the stroke at full as at friction load. The automatic engine at full load cuts off at about one-third the length of the stroke, but with a friction load the cutoff takes place early in the stroke. The average pressures of both full-load diagrams Y and A are the same, and the same is true at Z and B at friction load.

In a throttling engine when the cutoff takes place at five-eighths or three-quarters of the stroke, it allows only three-eighths to one-quarter of the stroke for expansion before the exhaust takes place, and the expansion is wasted into the atmosphere; whereas in the automatic-cutoff engine we get the advantage of the expansive properties of the steam in the engine. Supposing the cutoff takes place one-fifth of the stroke, we get four expansions, or at one-sixth cutoff we get five expansions, etc.

We will now consider the governing of both types of engines. At one time the majority of electric plants had belted dynamos and throttling engines. With this type of governor, there is an instant of time lost before the engine will respond to the increase or decrease in load; consequently a flicker in the lights will be observed.

Later years, there has been more demand for direct-connected, high-speed engines with an automatic cutoff. The advantages claimed are more horsepower per floor space, better efficiency and close regulation. A small automatic-cutoff engine running at high speed can develop the same horsepower as a slow-speed engine of larger size.

When a locomotive engineer is about to open the throttle of his engine to haul a train, he first observes that his reversing lever is in the gear in which he wants his engine to run, such as "forward, or back gear"; when the train moves ahead at a desired speed, he has his throttle wide open, but he pulls his reversing bar a few degrees toward the reverse position. By doing this, as in all reversing engines, the valve travel is shortened; in other words, he is giving it a shorter cutoff, and using the steam more expansively. The result is less coal burned, quiet running and less water consumption, but still retaining the speed.

Although a locomotive is a throttling engine, and the engineer acts as the throttling governor, at the same time we may say that a locomotive is an adjustable-cutoff engine. The amount of shortening the cutoff, however, is at the discretion of the engineer.

With the automatic engine, the speed is governed by the length of time the steam is admitted to the cylinder at full pressure. The reverse is true of the throttling-governor engine, which admits steam for the same length of time but at less pressure. Fig. 1 shows a balanced type of flywheel governor. The center of the shaft is *A*, and *B* is the theoretical center of the eccentric. The distance from *A* to *B* is termed the radius of eccentricity. In this position the valve is at its longest travel. If the radius of eccentricity is 2½ in., then the travel of the valve would be 5 in.

One end of each spring is secured to the arms *D*, and the other end to the wheel proper. Limit stops are secured to the wheel to limit the travel of the arms *D*. Fig. 1 shows the springs holding the arms against the stops *E*, which are the longest travel stops, and Fig. 2 shows the arms *D* against the limit stops *F*, which are the shortest travel stops. This figure represents the position of the governor when the engine is at its highest speed. The governor is actuated by the centrifugal force of the weights *W* in motion, which have a tendency to fly away from the axis of the shaft *A* as the speed of the engine increases. The coil springs can be adjusted so that a certain speed is maintained, or, to be more exact, the position of the governor determines the point of cutoff of the valve to maintain a given speed.

The opposing forces are the springs, so that should a sudden load be thrown on the engine, the wheel has a tendency to slow up. The springs at this moment take charge of the lost centrifugal force of *W*, and bring the governor back toward the position in Fig. 2. Whatever load is on the engine, the radius of eccentricity *AB* is varied as the governor varies, so that the valve travel is measured by the position of the governor. The sleeve of the eccentric is independent of the shaft of these engines. In Fig. 1 the valve would travel 5 in., and in Fig. 2 it travels 2 in. The relations as to position between the crank and the eccentric are the same as on the ordinary slide-valve engines.

The crank would be in this diagram at the top half stroke; the angular advance of the eccentric can be seen in Fig. 1. All governors of this type are the same in principle. One may differ a little from the other in design—plate springs may be used instead of coil springs, and an eccentric pin or shank instead of an eccentric—but in all kinds the principles involved in governing remain the same.

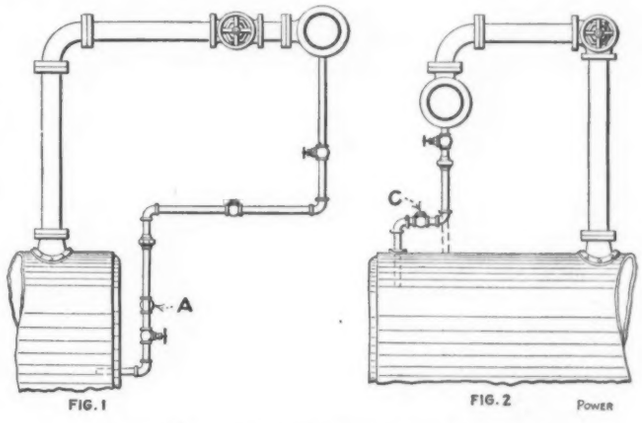
Draining Steam Headers

By James E. Noble

There are many different ways to drain a steam header, but the methods shown in Figs. 1 and 2 are the best that the writer has seen in use.

Fig. 1 is a good method if there are several boilers in the battery and it is desired to tap the header in one place only. If Fig. 2 is used, the header must be tapped for each boiler; if only one boiler was tapped and it was out of commission for repairs, etc., there would be no way to drain the header.

When a drain is connected straight down from the header, as shown by the dotted lines (in which case the



Two Kinds of Header Connections

two elbows and check valve *C* are not used), there is likely to be a break in the connections, caused by expansion; therefore it is not good practice to make connections in this manner, although it is sometimes done.

In Fig. 1, *A* is a tee from which a pipe is run behind the battery of boilers and a connection taken off at each boiler with a valve and connections below it, as shown.

For a single boiler, the drain pipe, Fig. 2, should be of ¾ in. diameter, but if there are several boilers, nothing smaller than 1 in. should be used.

The Designing Engineer Coming to His Own—A thought that has long been in the minds of many engineers was expressed recently in the statement that "the day is coming when the engineer will occupy the position now held by the architect." The speaker said that the public or office building is primarily an engineering problem in which the architect "farms out" 75 per cent. of the work. Moreover, this percentage is constantly increasing. He took the ground that the design of such buildings really belongs to the engineer who should be in charge and, if necessary, "farm out" the architecture. It is easy to see how this proposition will strike the architects, yet its accomplishment is not such a remote possibility as might be imagined. In more than one engineering office at the present time there is maintained a distinct "architectural" department, so that the office which is primarily that of a designing engineer for heating, ventilating, electrical and sanitary equipment, is at the same time fully prepared to handle the other structural features, including the architecture.—"Heating and Ventilating Magazine."

Combined Steam- and Gas-Engine Plant

SYNOPSIS—To handle the extra load occasioned by an addition to the Fort Pitt Hotel, gas-engine units were installed. They are run almost exclusively during the summer and part of the time during the winter. With increased output, the total cost has been reduced by this combination.

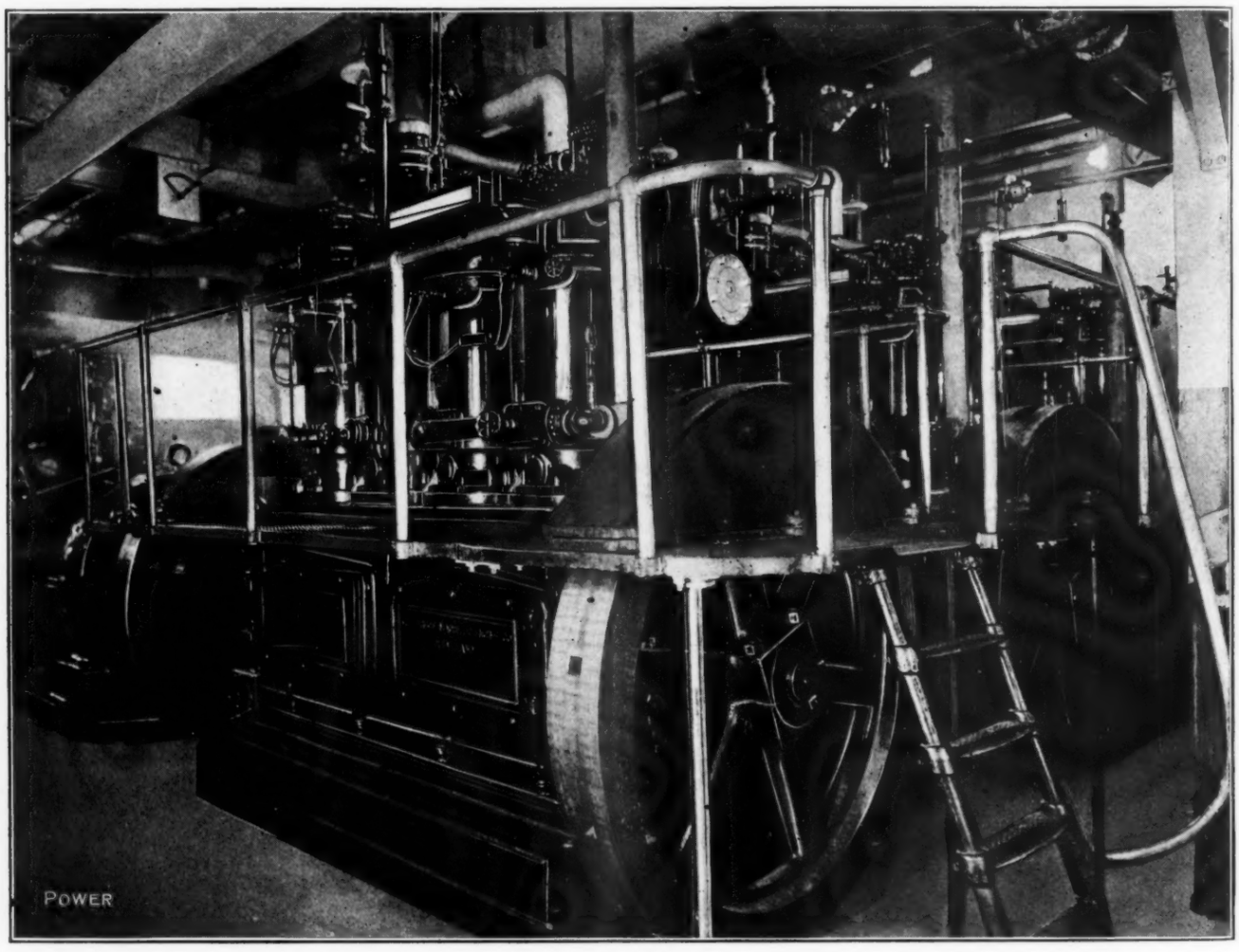
The Fort Pitt Hotel, of Pittsburgh, has its own power plant, which is a combination of steam and gas engines, the latter being installed in the fall of 1912 when the second addition to the hotel was made. The mechanical equipment consists essentially of three 316-hp. Heine boilers equipped with Roney stokers; two 250-hp. Erie-Ball four-valve engines; three 100-hp. slide-valve engines of the same make; and three 150-hp. Bruce-Macbeth, four-cylinder gas engines. Each of the engines is directly connected to a 125-volt direct-current generator. Besides the generating units there are two Frick ice machines, an air compressor for operating pneumatic tubes and air lifts, and the usual pumps, etc.

The three slide-valve engines were in the original equipment and are now seldom used. At all times enough steam equipment is run to heat the water by exhaust steam and in cold weather to heat the building. In summer the pumps and the ice machine furnish sufficient exhaust steam and the three gas engines are run almost continually. In winter the steam engines are run together with one or two of the gas-engine units.

For comparison of the straight steam plant with the combination steam and gas plant, two months are selected, January and June, 1912, and the corresponding months of 1913 after the gas engines had been added. During these periods the 30-ton ice machine ran almost continuously with an average of five tons of ice daily, the balance being refrigeration. The air compressor ran 24 hr. daily and the vacuum cleaner 12 hr., the two consuming about 200 lb. of steam per hour. The steam used in the kitchen averages about 20 boiler horsepower per hour for 24 hr.; that used in the laundry averaged 75 boiler horsepower per hour for 12 hr. a day in 1912 and 100 boiler horsepower for the same months in 1913.

The coal costs $1.70 per ton delivered and the natural gas 20c. per 1000 cu.ft.

The labor in 1913 was the same as for 1912, but there



GAS-ENGINE UNITS IN FORT PITT HOTEL

was an increase from 540 to 700 in the number of rooms served.

A COMPARISON OF FUEL COSTS DURING TWO MONTHS OF 1912 AND 1913

	January		June	
	1912	1913	1912	1913
Kilowatt-hours delivered	133,660	149,380	106,220	125,480
Gallons of water pumped	8,139,276	11,176,506	9,366,464	10,420,590
Cost of coal	$1,733.81	$1,474.07	$1,328.01	$885.95
Cost of gas	.....	157.80	.....	315.60
Cost of oil	84.16	94.06	89.95	103.64
Total cost (coal, gas, oil)	$1,817.97	$1,725.93	$1,417.96	$1,305.19

From the above figures it will be found that in January and June, 1912, 239,880 kw.-hr. were generated. The same months in 1913, when the gas engines were in use, 274,860 kw.-hr. were generated, an increase of 34,980 kw.-hr., or 15 per cent.

The water pumped in January and June, 1912, was 17,505,740 gal.; during the same months in 1913, 21,596,096 gal. were pumped, an increase of 4,909,356 gal., or 36 per cent.

The coal charges for January and June, 1912, were $3061.82 and oil, $174.01, making a total of $3235.83. For the same months in 1913 the coal charges were $2360.02, gas $473.40 and oil $197.70, making a total of $3031.12, which represents a decrease of $204.71, or 6.4 per cent.

The percentage of increase of steam used in the kitchen, laundry, for refrigeration, etc., could only be determined by exhaustive tests, but it is presumed that they have increased in somewhat the same proportion as the current generated. However, the figures show that the current generated has increased 15 per cent.; there is an increase in number of rooms of 29.5 per cent.; the water pumped has increased 36 per cent., and the fuel used has decreased 6.4 per cent. On a comparative basis of units of service, there was a decrease in cost of power, light, heat and water in 1913 over 1912 of 27.8 per cent., or a saving of 27.8 per cent. of the total cost of power by the addition of the gas engines. The cost of the gas-engine units, complete with foundations, piping, etc., was about $21,000.

Steam-Electric Power Plant at Hauto, Penn.--II

By Warren O. Rogers

SYNOPSIS—Each double-ended, 1000-hp. boiler has four furnaces. Forced draft of 5 in. of water pressure is furnished by three 6-ft. motor-driven fans. The coal is switched over and discharged into coal bunkers, and the ashes and cinders, loaded into standard-gage ash cars, are hauled away by a locomotive kept expressly for this work and for hauling coal.

As stated in the first article on the Hauto plant, the boiler house is built at right angles to the turbine house, the ground floor being about 2 ft. below the level of the gallery in the turbine room.

The firing floor is at the level of the crane track in the turbine room, and above this floor is the water-tender gallery along the fronts of the boilers.

Boilers

At present there are eight 1000-hp. water-tube boilers, the superheaters superheating the steam 100 deg. F. The double-end, five-drum, bent-tube boilers are designed to carry 225 lb. pressure, and the heating surface, exclusive of the superheaters, is somewhat in excess of 10,000 sq.ft. The center steam drum is 48 in. and the two outside steam drums, and the two mud drums are 42 in. in diameter and 23 ft. long; all are double-butt-strap jointed and double riveted.

The boilers are in a row on the stall system lengthwise of the boiler room. In the case of the six boilers, provisionally provided with hand-fired grates, the furnaces are 8 ft. wide and 12 ft. long, giving a grate area of 96 sq.ft., a total of 384 sq.ft. per boiler, or approximately 26 sq.ft. of heating surface per square foot of grate area. The adjoining furnaces are separated by a firebrick wall 35 in. thick and reach to the arches at the top of the furnaces. The bridge-wall separating the four furnaces at the center of the setting is 31½ in. wide and extends 3 ft. 1 in. above the rear end of the grates, which are 1 ft. lower at the back than at the front. The bridge-wall is ventilated by means of air ducts, arranged as shown in Fig. 6, air being supplied from a main intake. The air ducts are 3 in. in diameter and extend through the bridge-wall to the outside of the setting.

Furnace Arches

Between the boiler drums and the grates there are three sets of arches for each hand-fired furnace. The bottoms of the mud drums are protected from the direct action of the furnace heat by firebrick walls, Fig. 6. The boilers are designed with tubes six rows deep from the mud drum, running to the center steam drum. The outside steam drums are connected with the mud drum by tubes five deep. Baffles are placed between the larger bank of tubes and the superheater, and between the superheater and the outside bank of tubes for each half of the boiler.

Heated gases from all four furnaces pass to the center of the boiler and, striking the inside bank of tubes and baffle walls, go to the second pass, where the superheater is located, and then to the last section of the boiler, escaping to the stack.

Each mud drum is 7 ft. 9 in. above the grates. Between the brickwork and the supporting I-beams, insulating materials protect the metal from the furnace heat. The supporting arch is nearest the mud drum and is 9 in. thick, as are the other two arches; the lower one is curved to an 8-ft. radius; they are connected to the side walls, as in Fig. 7, which gives details of construction. The bottom arch extends 7 ft. 10½ in. into the furnace, the other two 9 ft. 4½ in., which brings them just beyond the inside brickwork around the mud drum. The

spaces between the arches are filled with suitable packing for a depth of 14 in. from their rear, and a limited amount of air is allowed to circulate through the spaces from openings at the furnace front.

Cinder and Ash Disposal

A pair of inverted hoppers at the bottom of each rear pass take care of the cinders deposited in the last pass of the boiler. The cinders settling on the hoppers run by gravity to the discharge chutes extending to the boiler-room basement, along the sides of the ash hoppers, where they discharge into the ash cars, Figs. 8 and 14. Each of the 32 ashpits has a $\frac{5}{16}$-in. thick metal hopper, stiffened with angle iron and lined with brick placed upon reinforcement bars carried through holes molded in the brick. Each ash car is air dumping and righting. This is accomplished by either of two air cylinders, one on each side of the car, using air from the locomotive handling the ashes and coal. The car body rests on pivot points along the center from end to end. A chain attached to the piston on each end of each cylinder is also hooked to a lug at each end of the car. When the ashes have been hauled to the desired dumping place (ashes are used for filling in at present), air pressure is admitted from the locomotive tank to one set of cylinders and the load is dumped, the piston and chain tipping the car to one side. A reverse motion of the piston in the opposite cylinder restores the car body to its original position.

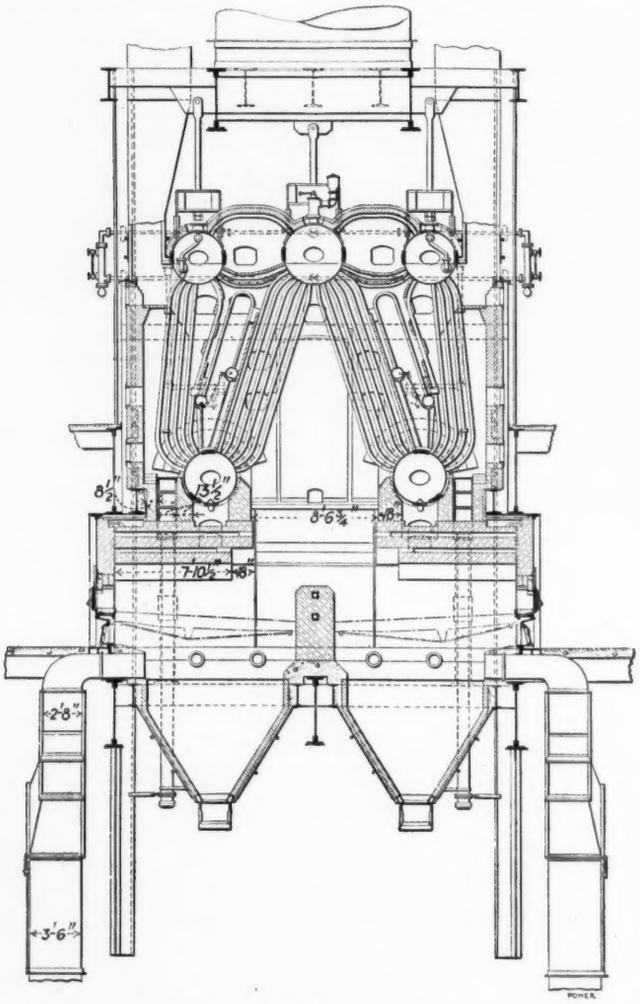


Fig. 6. Section through One of the 1000-Hp. Boilers, Showing the Arrangement of the Furnace Arches and Bridge-Wall

Furnace Grates

Six of the boilers have hand-fired dumping grates designed for burning anthracite coal of the finest practicable size. Four of these grates have slotted tops $\frac{3}{32}$ in. wide and two are pinhole top grates, with 6 per cent. air spaces. These are at the bottom of the grooves formed across the tops of the grates at right angles to each other.

The other two boilers will be equipped with traveling grates, one with removable piano-key grate tops supported on carrier bars, the other with removable pinhole grate plates. The lateral expansion of the piano-key tops is compensated for by expansion plates supported at each end of the carrier bars, as are also the grate tops. Inclined springs attached to the plates pulling from the sides toward the center force the tops of the plates to-

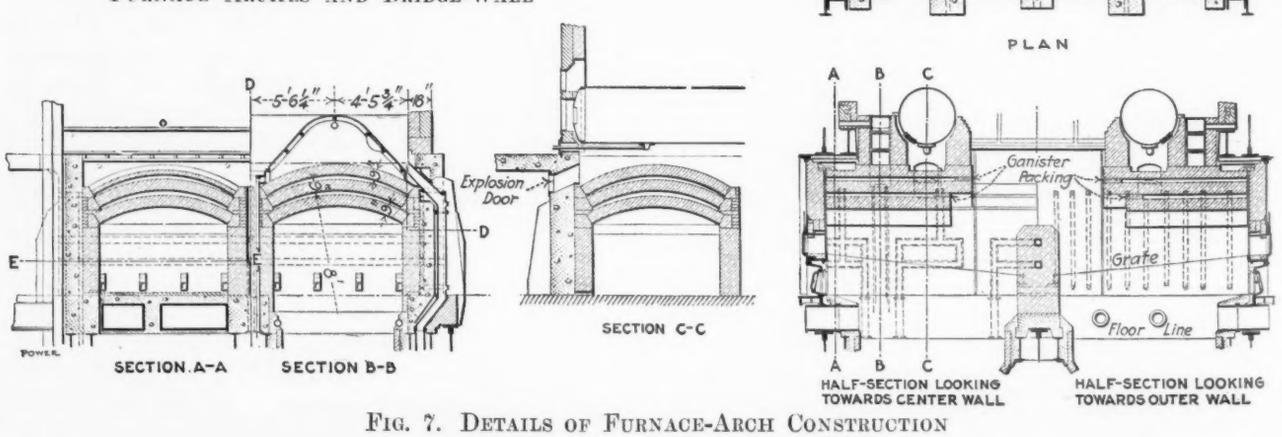


Fig. 7. Details of Furnace-Arch Construction

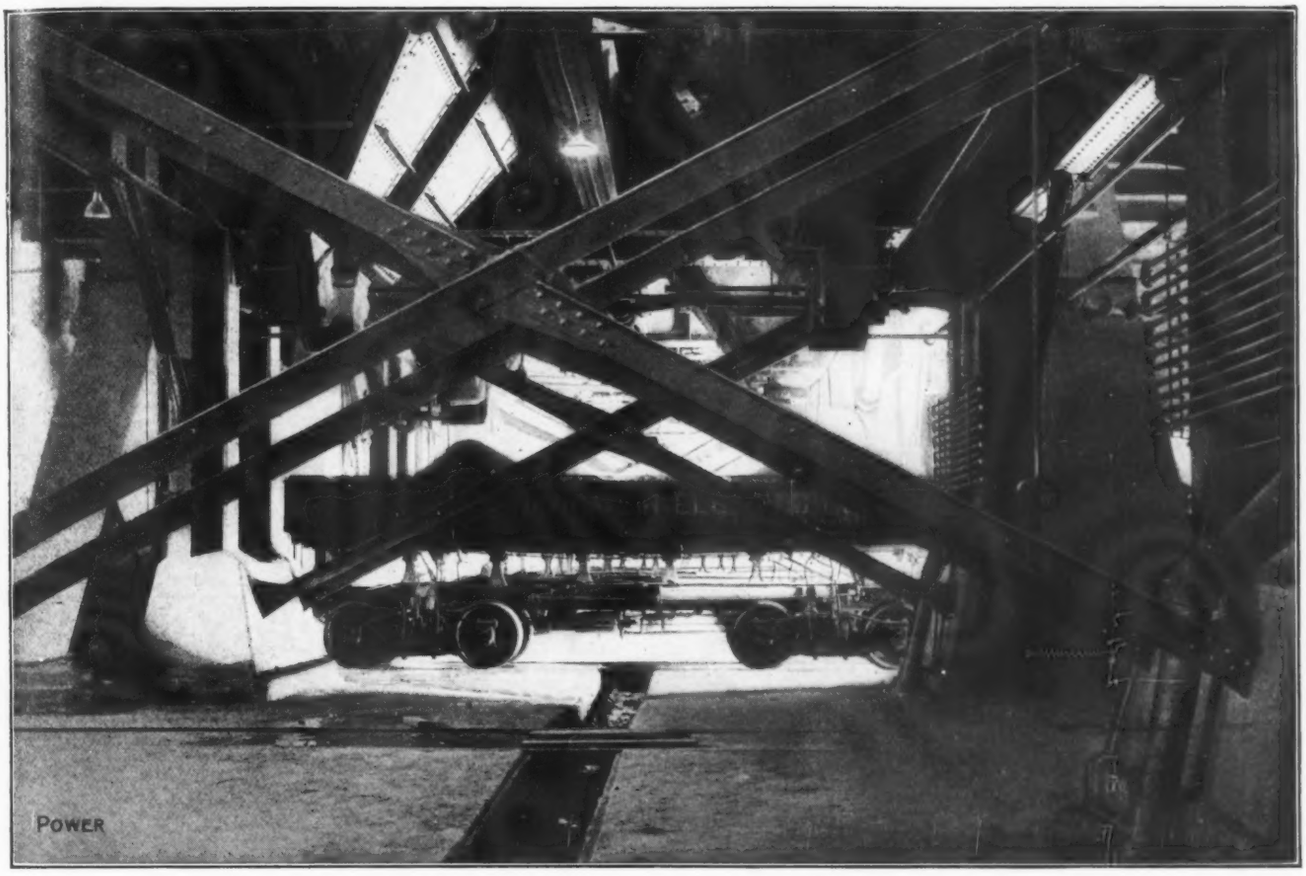


FIG. 8. ASH CAR UNDER ASH HOPPERS AND DISCHARGE PIPES FROM CINDER HOPPERS

gether. Both types of grate top overlap each other in the direction of travel to prevent the fuel from sifting through to the ashpit. Fuel will be fed by gravity from the bunkers to a hopper above the grates.

FURNACE

Each hand-fired furnace has three sliding firing doors, Fig. 9, or 12 for each boiler. At the top of each door a rod extends upward and is attached to a tilting arm pivoted on the girder shown. On the outer end there is a balancing weight so adjusted that the door will remain in any position. A pull rod of suitable length enables the fireman to manipulate the furnace fire-doors.

As the sliding doors prevent the escape of steam and water in case of a bursting tube, three explosion doors have been provided in each side of the boiler setting. They

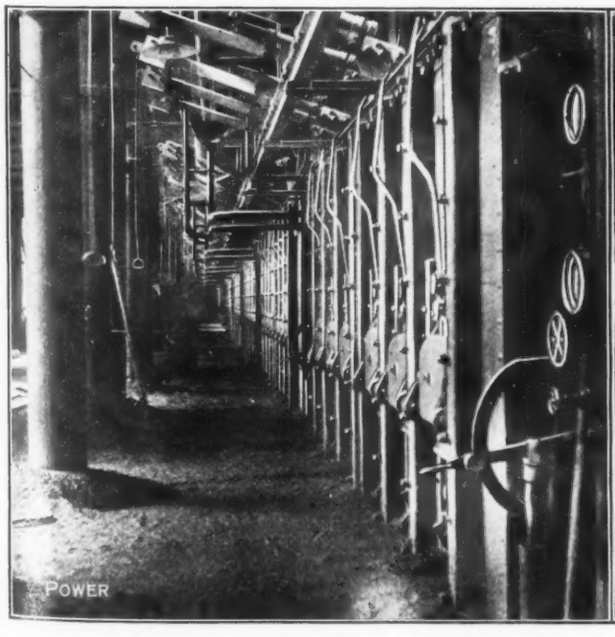


FIG. 9. VIEW ALONG THE FIRING AISLE ON ONE END OF THE EIGHT BOILERS

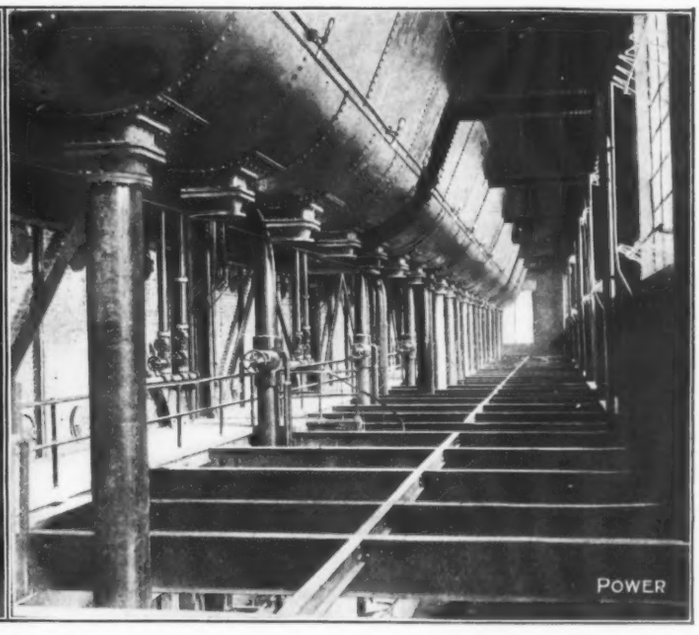


FIG. 10. WATER TENDERS' GALLERY AND COAL BUNKERS AT ONE END OF THE BOILERS

FIG. 11. LOCOMOTIVE HANDLING COAL CARS ON TRESTLE TO COAL BUNKERS

FIG. 12. COAL CAR OVER COAL BUNKERS

connect with the first pass of the boiler, and are 18 in. wide and 14 in. high. The two lower ones are 2 ft. 8 in. above the mud drum and are opposite each large bank of tubes. The top doors are 15 in. below the center steam drum, and central between the two inner banks of tubes, Fig. 6. In case a tube bursts, these doors are blown open and damage to the setting is prevented.

Four water columns on each boiler, two above each firing aisle and at opposite ends of the boiler, are connected to the center steam drum, although the bottoms of the three steam drums are on the same level. By this arrangement the water tender can determine the water level from each end of the boiler. The drums are tied below the center line by two sets of 3-in. tubes and above the center line by one set. The lower tubes are baffled above the top tubes and between the top and lower ones.

The steam drum and top tie tubes are covered by 5 in. of brickwork, over which 1¼ in. of asbestos cement is placed. Besides the four safety valves on the drums of each boiler there is also a valve on the discharge side of each superheater.

FUEL SUPPLY

Above the firing aisle is the water tenders' gallery, Fig. 10, and in the foreground may be seen the coal chute to the firing floor below. The six vacant spaces are for the spouts that will lead to the hoppers of the traveling grates.

There are four bunkers on each side of the boiler room, each bunker serving two boilers and holding 867 tons, or a total of 6936. These are single riveted and unlined.

Coal is hauled direct from the washeries to the bunkers, the cars being handled by a logging type of locomotive equipped with three cylinders on one side of the boiler, next to the cab. The crank rods drive a shaft geared to the driving wheels, a sliding coupling permitting the train to run over extremely sharp curves. Fig. 11 is a view of the engine and two empty coal cars. Fig.

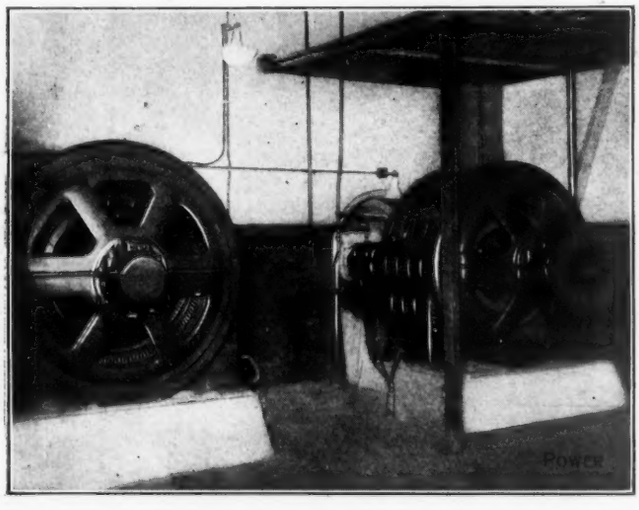


FIG. 13. TWO OF THE THREE 450-HP. INDUCTION MOTORS DRIVING THE FORCED-DRAFT FANS

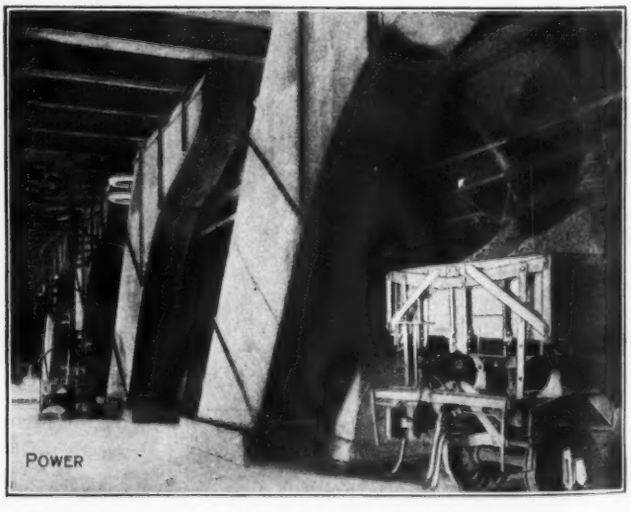


FIG. 14. AIR DUCTS LEADING TO BOILER ASHPITS FROM MAIN UNDERGROUND DUCT

12 shows a coal car above the bunkers ready to be unloaded. The rails are secured to heavy I-beams and the coal is dumped from hopper cars into the bunkers. The arrangement for handling coal and ash does away with all coal- and ash-conveying apparatus other than the locomotive which was used for handling material during the construction period.

All the boiler furnaces have forced draft, which is obtained from two of the three motor-driven fans in two fan rooms on a level with the turbine-room balcony and between the header room and the boiler-room basement.

Each fan is 6 ft. in diameter, 6 ft. long, and has a capacity of 22,900 cu.ft. of air per minute at 360 r.p.m., or a total of 68,700 cu.ft.; each is driven by a 450-hp. induction motor, Fig. 13, directly connected to the fan shaft. Sufficient air can be supplied by two blowers for the eight boilers under full load. Air is taken from outdoors, from the top of the boiler room or else from the turbine room through the pipe gallery.

Air from the fans is blown into two main concrete air ducts placed under the floor of the boiler-house basement beneath each firing aisle. These ducts are cross-connected at the end nearest the blowers, and any blower may be used to supply air to both tunnels. One serves all of the furnaces on the ends of the boilers to which it is connected, the other connecting with the furnace on the opposite ends. The ducts, 14 ft. high and 2 ft. 6 in. wide, extend the length of the boiler room.

The first two boilers are served by a single Y-branch duct, (Fig. 14) 12 ft. wide and 3 ft. 6 in. across, the latter is also the dimensions of the single-branch ducts, serving the remaining boilers, which are 8 ft. wide at the bottom. At the top, however, the width of the ducts increases to 19 ft., and reduces to 2 ft. 8 in. across. Each has four outlets, two to each furnace, which enter the ashpit at right angles to the branch duct and have dampers operated by the firemen by means of a lever and connecting-rods. The ducts entering each ashpit are of two sizes, one being 2 ft. 7 in. and the other 4 ft. 1 in. wide; both are 17 in. high, thus giving a total duct area at the ashpit of 1360 sq.in., a total for each boiler of 5440 sq.in.

Emergency provisions have been made for supplying the furnaces with forced draft by means of air-jet blowers, two being provided for each furnace.

The furnace gases escape from each last pass of each boiler to a vertical smoke flue of sheet metal, lined with insulating material below the roof line. They are of peculiar design, Figs. 15 and 16, to permit installing economizers at some future date by removing the side plates, Fig. 16, which will allow of connecting with the intake of the economizer; the outlet will connect with the opening now sealed by the top horizontal plate. The connection to the chimneys is shown in Fig. 15, also the tracks to the coal bunkers; the reservoir is shown at the left.

There are four steel stacks 157 ft. above the grates and 12 ft. inside diameter, or an area of 113.1 sq.ft., a total of 452.4. Each stack takes the furnace gases from two boilers, thus serving 768 sq.ft. of grate area. The chimneys are supported by the roof trusses; the stack cinders are collected at the bottom.

The third installment will deal with the piping system of the Hauto plant.

FIG. 15. SHOWING CONNECTIONS OF UPTAKES TO CHIMNEY, TRACKS AND RESERVOIR AT THE LEFT

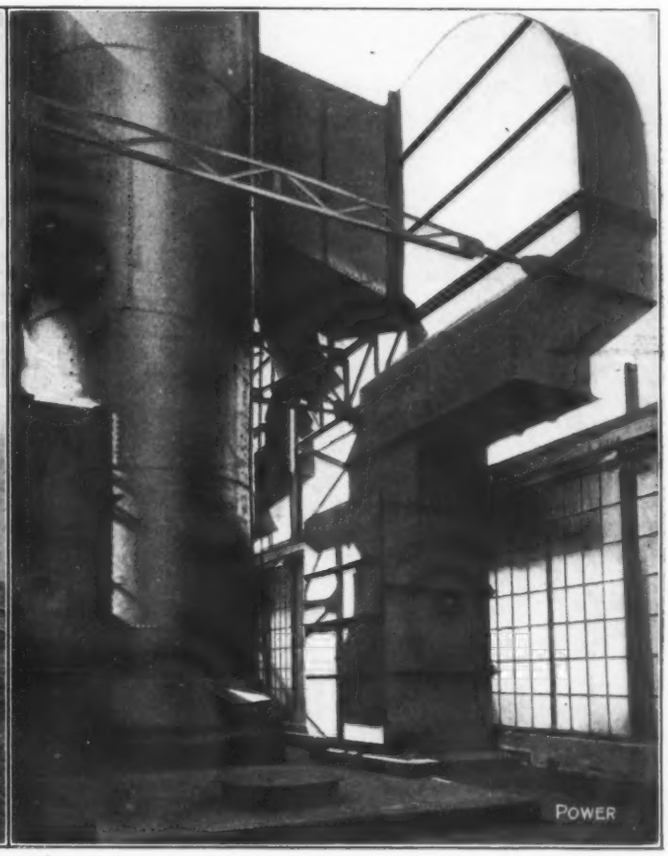


FIG. 16. ONE OF THE UPTAKES, SHOWING CONNECTIONS FOR FUTURE INSTALLATIONS OF ECONOMIZERS

Tests of Van-Stone Joints

To determine the relative merits of steel pipe, van-stone joints and acetylene welds, a series of tests were undertaken by the Simmons Pipe Bending Works at their plant at Newark, N. J., Tuesday, May 12, before a gathering of engineers.

A hydrostatic test was made on a 10-in. full-weight steel pipe, 5 ft. 6 in. long, one end of which was equipped with an ordinary van-stone lap joint with specially designed cast-iron heads, Fig. 1; the other end had a dished head, welded in by the oxyacetylene process. A water pressure of 3000 lb. per square inch was applied to the pipe without causing any perceptible change to the section. This test is to be repeated, carrying it to the bursting point.

A 6-in. full-weight steel pipe, 4 ft. 6 in. long was next submitted to a bending stress, the load being applied at the center. This pipe failed at a load of 16 tons, with a deflection of 2 in., Fig. 2.

Two 6-in. full-weight steel pipes, 4 ft. 6 in. over all and welded in the center by the oxyacetylene process, were subjected to a central load applied at the weld. This

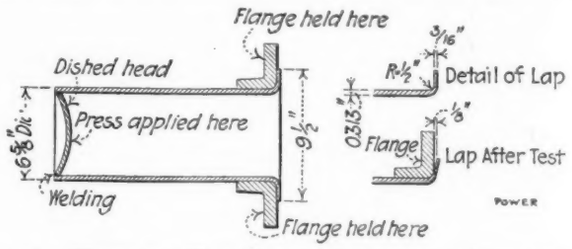
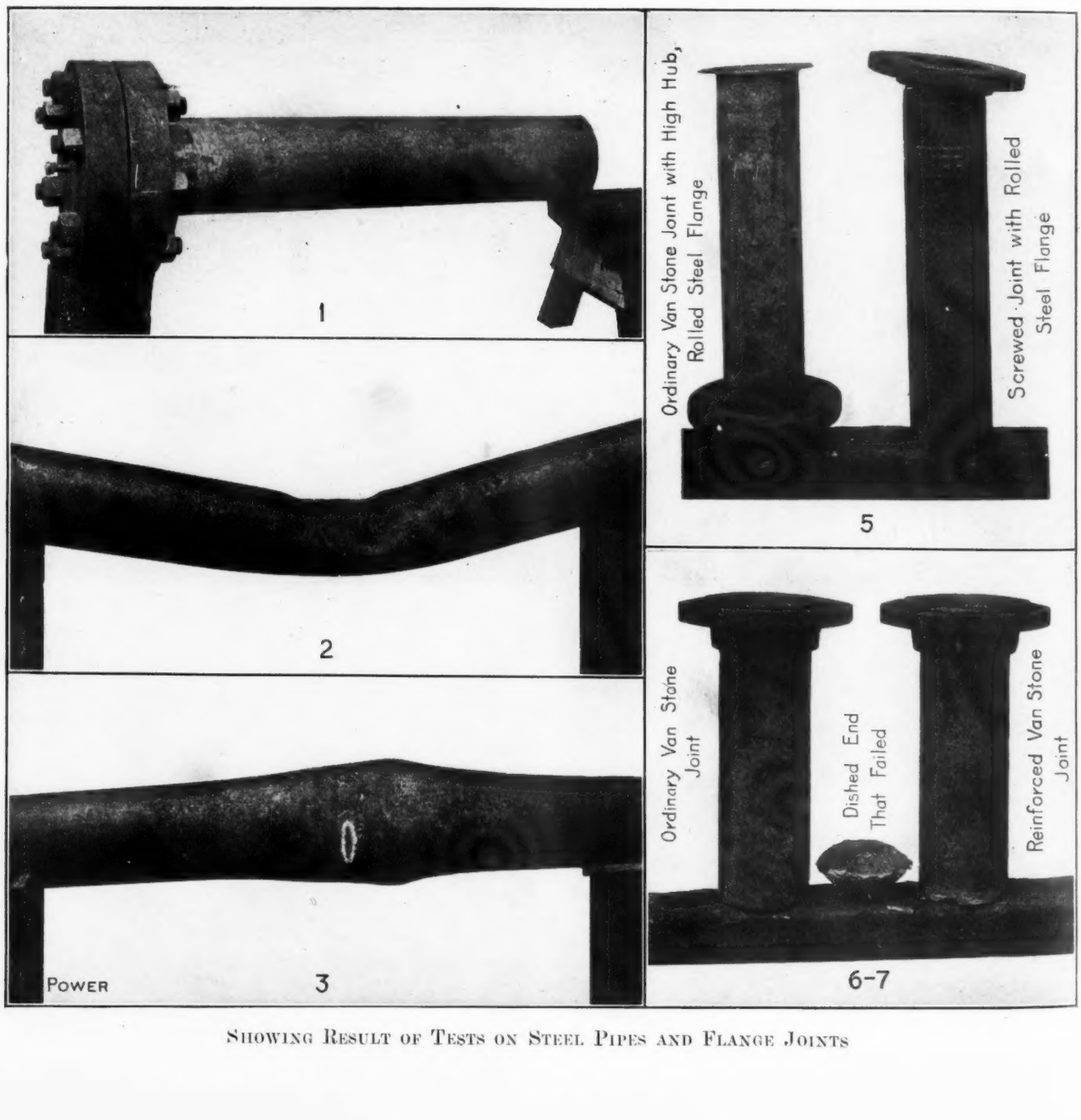


FIG. 4. TYPE OF VAN-STONE JOINT AND DETAILS OF LAP BEFORE AND AFTER TEST



SHOWING RESULT OF TESTS ON STEEL PIPES AND FLANGE JOINTS

weld failed under a load of 18 tons, with a deflection of 2½ in.; at 16 tons the deflection was 2 in. The piece failed at the weld on the tension side, the weld opening ½ in. for a length of 2 in., Fig. 3. The type of weld is shown in Fig. 8.

The next test was of two pieces of 6-in., full-weight steel pipe, 4 ft. 6 in. over all, one having an extra-heavy

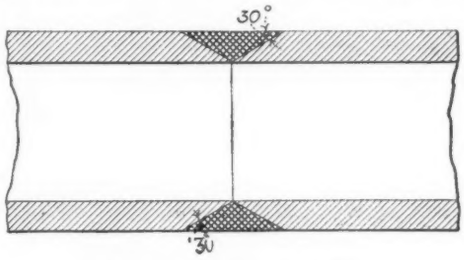


FIG. 8. TYPE OF WELD

rolled-steel flange screwed up; the other piece was fitted with an extra-heavy, high-hub, rolled-steel flange with ordinary van-stone lap. These two flanges were bolted together, and load applied at the center. One pipe failed under 12 tons pressure, breaking at the threads. The deflection at the instant before breaking was 1 in. Fig. 5 shows the result of the test, the van-stone lap being bent ¼ in. out of line.

The fifth test was with a 6-in., full-weight steel pipe, one end of which was plugged with a dished head welded in by oxyacetylene; the other had an ordinary van-stone joint. This piece was inserted in the test press, and pressure was applied tending to draw the lap through the flange. The lap started to straighten at 20 tons; the pressure was then carried to 60 tons without further change (see Fig. 6).

The same test was made on a pipe with a reinforced van-stone joint, a lap turned back upon itself. The lap

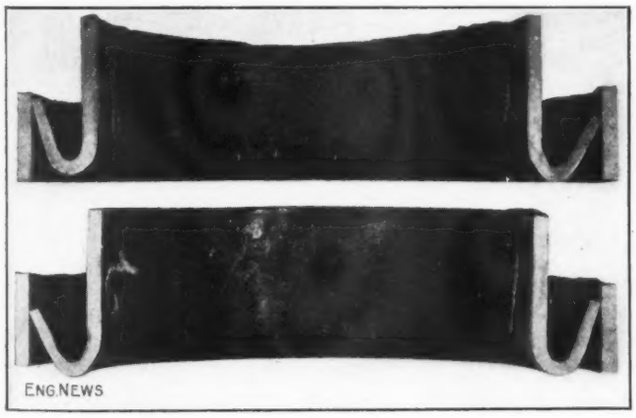


FIG. 9. FORCING A VAN-STONE JOINT THROUGH A PIPE AT 53 TONS PRESSURE

started at 20 tons pressure and was then carried to 60 tons when the dished head failed at the weld, Fig. 7.

Another interesting test to prove that the van-stone joint is strong enough for any normal service was run in March. The van-stone flange on a 10-in. pipe was hammered flat, cold; the outside diameter of the pipe and lap was 14½ in. The pipe was placed against a 14-in. pipe and pressure applied. The van-stone lap on the 10-in. pipe was bent back and the pipe pushed cold through the 14-in. piece under 53 tons pressure. The lap was not fractured. The final condition of the lap is shown by Fig. 9.

Facilities were also given to see bending, welding and van stoning. The tests were in charge of M. Wesney Ward, mechanical engineer, New York representative of the Simmons Pipe Bending Works, 30 Church St., New York City.

Locating Trouble in Air Compressor

BY T. G. THURSTON

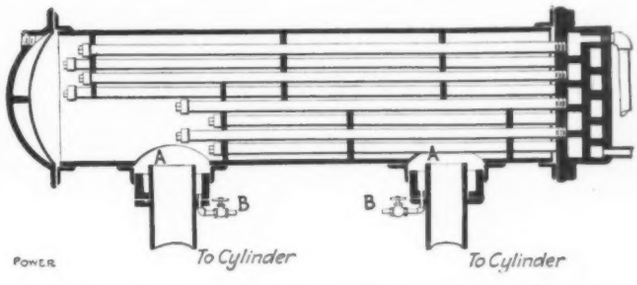
A large two-stage, cross-compound air compressor, the discharge pressure being 120 lb. and the receiver or intercooler pressure normally about 30 lb., was hurriedly installed. For a few weeks it ran well, then a knock developed in the high-pressure cylinder. The knock came at irregular intervals and the receiver pressure began to gradually increase week by week.

When the high-pressure discharge and inlet valves were taken out they were corroded and badly gummed, and a large amount of grit and dirt had accumulated on them and in the discharge ports.

The valves and ports were cleaned, the valves replaced, and upon starting the compressor worked a little better, although the receiver pressure did not come down to where it should. A few days later the knock again announced itself and the receiver pressure gradually increased to 60 lb.

The low-pressure journal bearings pounded badly, due to the excessive receiver pressure. Then the high-pressure cylinder was opened and the piston taken out. A piece about 3 in. long was found broken out of each ring and the rings were worn down to ⅛ in. in places. The air passages from the discharge side were filled with a gritty, gummy substance resembling brick dust mixed with oil, and some of it was baked quite hard.

The intercooler was placed horizontally across the two air cylinders, as shown in the illustration. Much water accumulated and found its way into the pockets *AA*, around the air passages leading to the air cylinders. These were provided with pipes and valves for drawing the



SECTIONAL VIEW OF INTERCOOLER; NOTE DRAINS

water off regularly, but this had not been done as often as necessary, and, consequently, the water got into the high-pressure cylinder. Added to this, the air had been taken from the basement directly under the compressor, which was damp and full of dust from the construction work going on.

Two new rings were made for the piston, the air intake was piped to the roof and a trap connected to

the two pipes *BB* to insure the water being taken away as fast as formed. When the compressor was started the receiver pressure showed only 27 lb., and the machine ran quietly and has not caused any further trouble.

Self-Synchronizing Rotary Converters

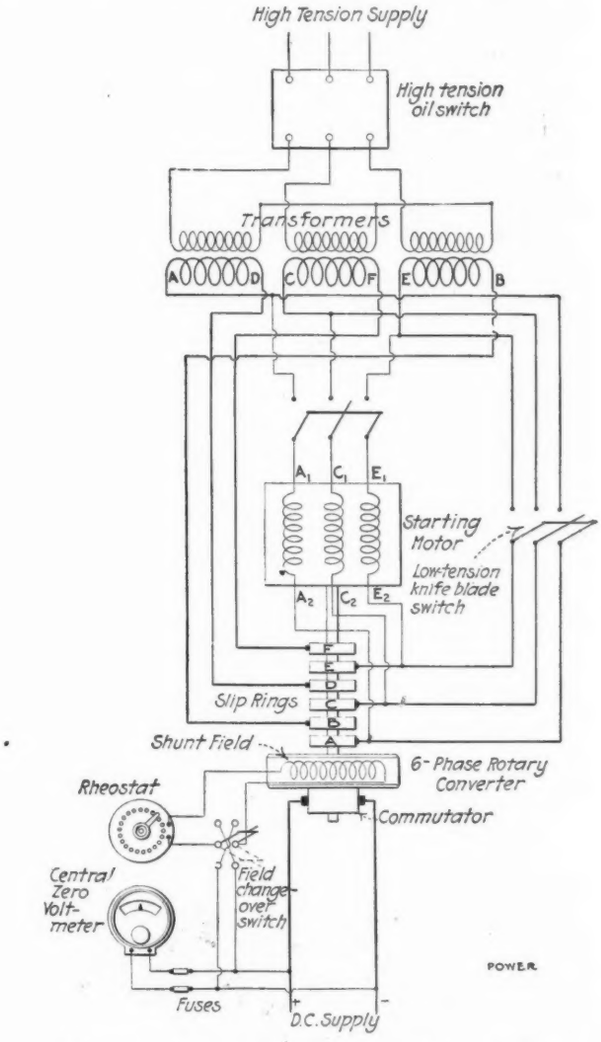
A new method of making rotary converters self-synchronizing is being adopted extensively by British manufacturers. With it the complications of a synchronizing gear and starting taps on the transformers are avoided, and the delicate operation of synchronizing is dispensed with. The starting current required is also reduced to the lowest practicable limit. There is a squirrel-cage starting motor with each converter, its stator being wound for the voltage of the main transformer secondaries. The electrical connections are shown in the diagram.

It will be seen that each of the three phases of the stator of the starting motor can be connected in series with the converter slip rings. The gear consists of the usual three-pole, high-tension switch on the primary side of the transformers, a three-pole, low-tension switch in the main alternating-current circuit to the converter, a smaller three-pole switch for the starting-motor stator circuit, a central zero direct-current voltmeter, and a field change-over switch. At starting, all these switches, including the field switch, are opened and the oil switch on the high-tension side of the main transformers is then closed. Now, upon closing the motor-starting switch, the low-tension alternating-current circuit is completed through the starting-motor stator, and the machine starts. Owing to the high impedance of the starting-motor windings, the starting current is reduced to a small amount, with the result that no sparking takes place at the commutator, and none of the disturbances incidental to heavy starting currents is created in the alternating-current system. These two are most important points and constitute the chief advantages claimed for the new method of synchronizing.

When the converter passes through the synchronous speed, the voltmeter pointer will oscillate between a small positive and a small negative indication, or *vice versa,* every time a pole is slipped. If the converter-field switch is closed when the voltmeter indicates the proper polarity, the converter will excite and remain steadily in synchronism. After adjusting the field so as to show approximately the correct normal voltage, it is necessary only to short-circuit the starting-motor stator by closing the main low-tension alternating-current switch. The converter being in synchronism before this switch is closed and excited to full normal voltage, the closing of the switch causes neither a heavy rush of current nor any sparking at the commutator.

An indicating lamp is sometimes connected across the main low-tension switch. This lamp will flicker before synchronism is reached, and will be dark after synchronism. However, since complete indication of synchronism is given by the voltmeter, this lamp is not essential.

Moreover, the three-pole switch in the starting-motor circuit is not essential; it is provided merely for convenience. If this switch were not provided, the converter would start as soon as the high-tension switch was closed. If the latter is in close proximity to the converter, there is, of course, no objection to this arrangement. It should also be noted that, under certain conditions, the field circuit may be closed before the starting operation commences. There is no danger of the machine coming up with the wrong polarity under these conditions, because the starting current is too small to interfere with the residual magnetism already existing in the machine.



WIRING OF SELF-SYNCHRONIZING CONVERTER

Tests on actual machines show that, with this new method, rotary converters of 1500 kw. and above can be started and synchronized in from 30 to 50 seconds.

One Dollar per Kilowatt per Month—The electric current used in the Rupert High School, Rupert, Idaho, comes from the government power house at Minidoka Dam, 14 miles above Rupert, on the Snake River. It is distributed by the Rupert Electric Co., and sold at $1 per kilowatt per month, for heat, flat rate. The current passes through a transformer of 300 kw. capacity, three-phase, Westinghouse self-cooling type, filled with oil. This transformer will stand an overload of one-third, so that a maximum of 400 kw. is available. The transformer is fed from the 4000-volt, four-wire distributing system of the Rupert Electric Co. by underground cable. This school is said to be the first large building in the world to be heated by this system of electric heat. The board of education and the superintendent of schools had such faith in the feasibility and economy of the system that the building was erected with absolutely no provision for the installation of any other heating system.—"Heating and Ventilating Magazine."

Editorials

Does Superheated Steam Dissociate?

Are there different kinds of superheated steam?

We do not now refer to the possibility of the existence of unevaporated moisture in a mass of superheated steam, the temperature of which is above the boiling point of the moisture. It has been demonstrated, if it needed demonstration, that water can exist for a limited time in an environment the temperature of which is above its boiling point just as a cake of ice can endure for a time on the curb in the sweltering sunshine of a summer's afternoon.

This discussion points in the other direction—up the scale, to dissociation.

E. A. Geoghegan claims to have a superheater the product of which is so much different from the steam put out by the garden variety of superheater that it can be used at over nine hundred degrees with impunity and oil hemp packing, whereas the degree of superheat which can ordinarily be usefully applied is limited by its effect upon the lubrication, packings, fittings, etc., to from one hundred to two hundred degrees.

The reason, according to Mr. Geoghegan, lies in the fact that in his superheater the temperature of the steam is brought up gradually, avoiding any tendency to decomposition, while with most other types a thin sheet of steam is impinged against surfaces at almost a red heat, affording ample opportunities for local heating above the thirteen hundred degrees needed for decomposition in the presence of iron or steel of that temperature. The oxygen eats up the superheater and the liberated hydrogen goes on to play heck with the engine and piping.

If this condition exists, it would be well to establish the fact and correct it. Cases have occurred where superheaters have oxidized badly, but they have been exceptional. Mr. Geoghegan claims that if a torch be held in front of a two- or three-inch outlet in a pipe leading from some types of superheaters carrying, say, two hundred and fifty degrees superheat, and the valve controlling the outlet be opened and closed quickly, there will be a very noticeable explosion of the hydrogen present in the steam. If this is so it ought to be easily capable of positive demonstration, and even the amount and composition of the gas determined.

The dissociation of steam at thirteen hundred degrees is not a spontaneous agreement between the atoms of hydrogen and oxygen that things have become too hot for them to get along together, but to the interference of the interloper steel or iron, for which, at thirteen hundred degrees, the oxygen has a greater affinity than for the hydrogen. If decomposition does take place in this way it is a serious matter, for each pound of steam so decomposed would eat up more than two pounds of superheater.

Dr. Augustus H. Gill, of the Massachusetts Institute of Technology, in an article discussing the decomposition of steam, in POWER of Jan. 28, 1913, cites Lowenstein and Wartenburg as having shown in 1906 that at two thousand and sixty degrees Fahrenheit (about the melting point of average cast iron) steam was but 0.0086 per cent. decomposed, and even at a temperature but little above that of melting wrought iron (twenty-nine hundred degrees Fahrenheit) only one-third of one per cent. was dissociated. This means that in cast-iron or wrought-iron containers practically no steam can be decomposed into hydrogen and oxygen; and if there were any of these gases formed, inasmuch as the reaction by which they are formed is under the conditions a reversible one, that they will recombine the moment the temperature is lowered.

In view of this a demonstration of the existence of the conditions claimed by Mr. Geoghegan is essential to the serious consideration of the merits of his system. Such a demonstration is easily possible, but so far as we know is yet to be made.

*

Summarizing Power-Plant Operating Reports

It is widely believed that in large plants only is it worth while to maintain exhaustive records of operation. This is a mistake. Besides, the fundamental data relating to fuel consumption, labor costs, supplies and repairs recorded, there is a field for analysis which offers a sure reward to the student of station economics. In this branch few are more interesting than summaries of operation upon a weekly, monthly and yearly basis.

Engineers prefer to make up their own forms of log sheet, but the good points in others may be profitably incorporated insofar as they fit the conditions. Power-station accounting varies as much as does that of other departments, but the opportunity for the standardization of summaries within the plant and for comparisons with other stations of similar or different types is sometimes overlooked.

The summary sheet of a large turbine plant in which more than usual attention is paid to record keeping contains about fifty items and nearly seven hundred entries in the course of a year. The items need not be enumerated in detail, but an outline is suggestive, not only because it shows the care with which the large station is studied, but because many of the items can be applied to the small plant at a nominal cost.

The sheet contains space for itemized totals by the month and for the year for fuel, water, oil and waste, etc., labor and material costs by months, with repairs upon major equipment units, kilowatt-hour essential costs, and the cost of coal per ton in the bunker. These items are supplemented by average monthly barometer readings, average vacuum, steam pressure and superheat at the throttle. Going deeper the sheet shows for each month and for the year the total kilowatt-hours output of each generating unit and of the station as a whole, the hours each unit was operated and the maximum load carried by

each unit, as well as the station peaks. To complete the record, the summary shows the number of boiler hours, steaming, banked and lighted. The load factor is figured in two ways: First, by dividing the average load by the average maximum, and, second, by dividing the average by the maximum. The last item is of great value as it shows the relation between the demand upon the equipment for regular service and the equipment which must be carried to meet extreme calls upon the station for service.

Data of the foregoing character represent but little work when merely transcribed from daily log sheets, and those which require averaging are easily procured if carried forward from day to day; if left until the end of a month the task is likely to be burdensome. From the operating standpoint, the value of being able to see all the "high spots" by the month and for a year at a time need not be emphasized. The more these side lights are heeded, the better. Daily log sheets are essential to proper service, but summaries of plant operation extending over substantial periods are important aids to its real behavior and many irregularities are smoothed out or may start an inquiry of ultimate benefit. In the course of a year, every station passes through a complete long cycle of performance, a record of which is the best means of analysis available to the engineer.

A Mistake Avoided

Years ago a condensing engine was (and in England to a large extent, still is) considered the only kind to install, because it is the most economical of steam. Then engineers came to appreciate that under certain conditions an engine is a first-rate reducing valve and the power it generates really a bonus, if low-pressure steam is required anyhow. Condensers, where they belong, are among the most important parts of plant equipments, but they are decidedly out of place in any plant that has use for all of its exhaust steam; such a plant is that of Reid, Murdoch & Co., described on other pages of this issue.

It is enlightening to follow the reasoning as set forth in the article referred to for not installing condensers. If all consulting engineers would use as much sense in analyzing the requirements of their clients before they put in unwarranted equipment, there would be more satisfaction all around. Incidentally, it would be a mighty good thing in the end for the manufacturers of the equipment omitted under such conditions. Fruitful soil is the only kind worth cultivating.

Engineering Salesmen

The foreword this week holds out two directions in which an operating engineer may hope to progress. One is quite obvious; advancing to a position of greater responsibility in the plant where he is engaged, as the superintendency of the works. Not so common is the other, that of salesman for the manufacturer of some line of equipment that he has been handling. Probably, it will come to many operating men as a new thought that there is a future for them in the selling field.

This idea appeals to us, and for some reasons besides those cited by the author of the foreword. As he says, we have a tendency to put confidence in the engineering salesman who shows a knowledge of his product in use. He is expected to be versed in the excellence of his goods so far as its manufacture is concerned and the material entering into it, but it is seldom that he can speak from experience as to its performance in operation. What he knows about what it does is usually second-hand knowledge picked up from his customers.

It has been the habit of manufacturers to recruit their selling force from the ranks of those who have the selling knack—and this, all too often, is based on the possession of a personality that wins friends, or a gift of persuasive speech. Not to discount these qualities, for they are highly important in any salesman, we maintain that they should be secondary and not primary considerations where the goods to be sold are of a nature such that the average individual cannot understand all that they involve in a short acquaintance with them. Any good salesman from his general knowledge, may quickly come to appreciate what distinguishes the good from the bad in cloth, or groceries, or a thousand other common commodities. Not so with anything so complicated as a piece of machinery, or even lubricating oils or fuel. Actual handling of these in use gives a man the customer's point of view as nothing else can. Where he can go to the prospective buyer forearmed with a knowledge of what his difficulties have been and how they may be overcome, the salesman's chances of a cordial reception are sure to be vastly increased.

Just as surely as the time has passed when the salesman needed to be a good mixer and stand treat generously to get orders, just so surely is the practice dying out of engaging men for their ability in the use of words. There is no denying the psychological effect, akin to hypnotism in some cases, of a flow of language that can sweep away doubts. This may make a first sale, but when the salesman has departed the goods must stand on their merits. If the buyer has been persuaded to take something ill-adapted to his needs, more harm than good has been done.

Let the next salesman who comes be a real engineering salesman. He can explain why the last trial was a failure and how to use his wares with success; thus a permanent user has been acquired. It goes without saying that the product sold must be deserving, but, given a worthy line and a salesman who is expert in the use of it, then the mere spellbinder has no chance.

Speed the time when more real engineers become engineering salesmen!

That likeable character, Chief Teller, who figures in the Will Quizz, Jr., articles, has been discovered in real life. Read the letter "When Ignorance is Folly," on page 864, and you will find that the writer once worked under such a chief and is now that kind of a one himself. "May their tribe increase."

The highly commendable action of the Swedish government in making an appropriation whereby Swedish engineers may be enabled to visit the Panama-Pacific Exposition, could be profitably imitated by other nations. The engineering congress alone has aroused the interest of forty-two countries, and will be of broad educational value. The trip would also afford the visiting engineers an opportunity to visit the great industrial works in this country.

Correspondence

Settling Trays

The writer has obtained good results by the use of settling trays inside of return-tubular boilers. They are especially good in sections of the country where the water is muddy. One tray hung near the water line, with the feed pipe extended so as to empty into it, will arrest a large part of the solids. A tray suspended below the tubes from the through stays or supported from the bottom will also catch that sediment which would otherwise settle on the fire sheets, for the reason that the current of circulation is upward at the sides of the boiler and downward in the center.

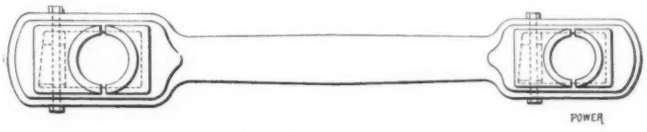
F. W. Schneider.

Clay Center, Ohio.

Bronze- vs. Babbitt-Lined Brass Boxes

Last summer I worked in a power plant which was undergoing a general overhauling. The care of the machinery is equally divided among the engineers and each is held responsible for the units allotted to him.

While the machinery is in operation the engineer on duty keeps it in service as long as he sees fit, and in



Type of Rod

cases of emergency, he is allowed to make minor repairs, which he enters on the daily report sheet. This rule works well as one man cannot blame the other for tampering with his machines, and it also enables the management to place the responsibility where it belongs.

Shortly before one of the engines was taken out of service for general repairs, the crankpin box got hot and melted the babbitt metal just enough to fill the oil grooves and allow the brasses to come together. The engineer took the brasses down, cleared the oil grooves and replaced them, but without filing a clearance because new brasses were to be put on soon.

The new set was of a bronze composition, with babbitt buttons equally distributed over the bearing surfaces. The engineer objected to them. He said that the bronze boxes would get hot and ruin the crankpin; they would always be a source of trouble. His superior, however, said he would take the responsibility and told him to put the brasses on.

When the repair work was completed and the engine put back into service, it ran for only a short time before the brasses got hot. They were taken down and refitted, but in two days they got hot again. The engine was then taken out of service for several days while the old brasses were being rebabbitted.

I wanted to ask the engineer why he did not chip the edges of each half of the old brasses for clearance and put a liner behind them. This would have raised the wedge and made the rod its original length.

The brasses contained one-fourth inch of babbitt metal when they came together and the only thing they needed was the above treatment. However, as it was against the rules to ask questions or take suggestions from anyone, I decided not to ask. The management claimed that the bronze boxes were those that the builder furnished with the engine, and that they ought to have been put on before; but why did they heat?

I know of brass boxes that are in service, and of engineers who will not have anything else. They keep them keyed up brass to brass, and go to the trouble of taking them down and filing off the edges every time it is necessary to key them up. This is good, as it decreases the wear between the brasses and the strap.

The sketch shows the type of stub end referred to. I would like to hear from some of the engineers who are running brass boxes on crankpins.

Robert P. Harris.

Washington, D. C.

Automatic Shutoff for Water Valve

As the engineer is not only responsible for his own work but also for that of others, it is up to him to devise ways of eliminating the risk of forgetfulness on their part during his absence. The more extensive the plant, the greater the possibility that something may be forgotten.

When the new wing of a certain trade school was erected with the basement one story lower than that of the main building the vacuum pump for the heating system had to be placed over 200 ft. from the engine room. It was necessary to use a jet of cooling water in the return to the pump.

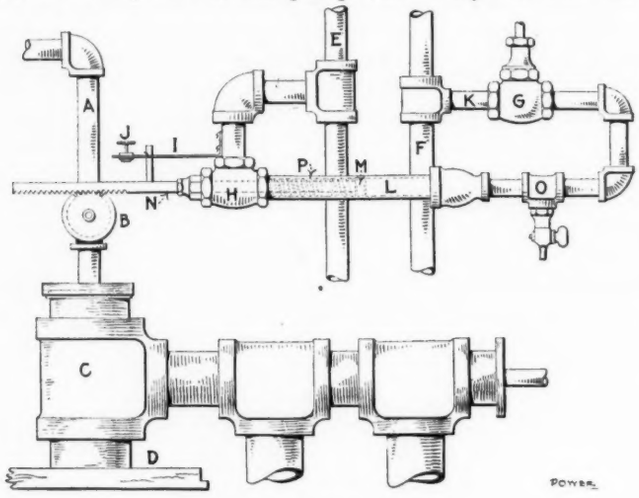
It was a common occurrence for the night man to forget to close this water valve after shutting off the steam in the engine room. Then the whole heating system would be filled with water, causing leaks and a delay in heating the building in the morning. To avoid this nuisance and to make the system entirely automatic, the following device was attached to shut off the water when the steam was off.

To a ¾-in. angle-valve body *H* with the stem removed there was screwed a 6-in. piece of ¾-in. brass pipe *L* for a cylinder. A piston *M* was fitted in this pipe and attached to a ⅜-in. steel rod *N* having a toothed rack several inches long, which meshed with the gear *B*. This gear replaced the handwheel of the valve on the cooling water pipe *A*. From the side of the valve body *H* a pipe was attached to the exhaust pipe *E* of the pump, so that any steam leakage past the piston would go into the heating system.

Back of the piston *M* there is a spring *P* of the proper tension to resist about 80 lb. steam pressure. A small

pipe K is led from the pump steam-supply pipe F to a reducing coupling on the cylinder L. In this pipe there is a valve G and a cock O for cutting the device out of use. The amount of opening of the cooling-water valve is governed by the pin on rack N coming in contact with the stop J, which may be adjusted to the requirements for outside temperatures.

The operation is as follows: When the steam is turned on slowly in the engine room and the pressure reaches 15 or 20 lb., the vacuum pump starts. By the time the



PIPING ARRANGEMENT

steam pressure in the pipe F is high enough to compress the spring, the returns will be hot and ready for the cooling jet.

The pressure on the piston M compresses the spring P operating the rack N, and gear B opening the cooling-water valve, in which position it remains as long as the steam is on.

In shutting down, the spring will close the valve before the vacuum pump stops, thereby allowing the system to be cleared of water. It is not necessary for the engineer to make a trip to the pump pit to operate this valve, and it is impossible to open the valve or leave it open when the steam is shut off.

W. E. SEWARD.

Worcester, Mass.

Oil in the Clutch

An induction motor which starts under load, on split phase, has a clutch which automatically engages with the shaft at speeds exceeding a certain predetermined value. The speed at which the clutch throws in and starts the shaft depends upon the adjustment of a spring against which centrifugal force acts. If the tension of this spring is too weak, the clutch will operate too soon, with the result that the drag due to the load will slow down the armature. On the other hand, all spring tension above that required will work against centrifugal force and decrease the force with which the core grips the shaft at synchronous speed. In any event, oil in the clutch will render it inoperative for sustaining appreciable loads.

An operator claimed that his motor heated and that it was not big enough for the work. Inspection showed that the whole motor, including the clutch members, was saturated with oil and that all of the heat came from slipping of the clutch on account of the oil. On disassembling the motor and giving all parts a gasoline bath, operation became normal. The oil in the motor was there as a result of carelessness in putting oil into the bearing on the clutch end.

J. C. HORTON.

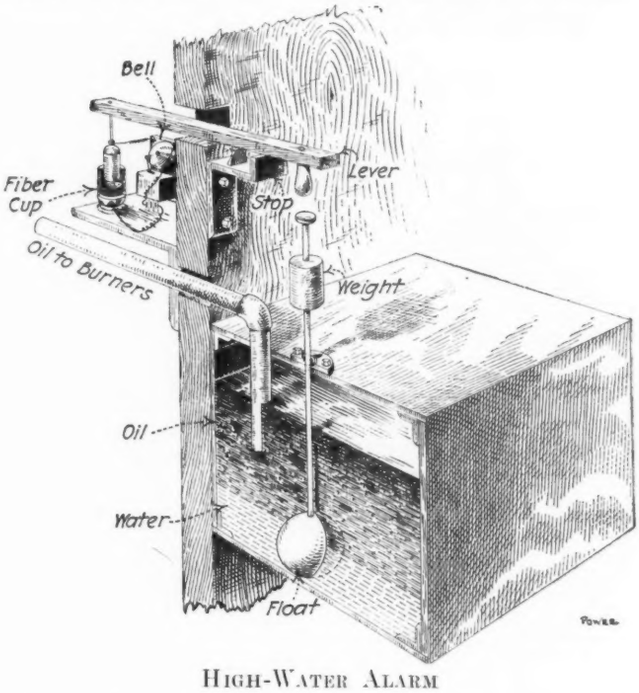
Schenectady, N. Y.

Protective Apparatus in Power Plants

Interruptions of service supplied from large power stations are so far-reaching in effect that it is most essential to safeguard against oversights and errors by operators and station attendants. In stations depending on liquid fuel for the boilers there is always the danger of water held in suspension in the oil settling in the bottom of the auxiliary oil tanks and accumulating sufficiently to get into the oil lines and burners, thereby putting out the fires and resulting in a loss of steam pressure until such time as the pipe lines may be drained and refilled with oil.

The illustration shows a novel device for detecting the presence of water in oil tanks. It has been tried out and found to operate successfully in a large steam-generating station where it is the aim to reduce service interruptions to a minimum.

The device consists of a float, the adjustment of which depends on the difference in specific gravities of oil and



HIGH-WATER ALARM

water, and an electric bell so connected that when the water accumulates to a certain depth in the bottom of the oil tank the float closes a contact in the bell circuit and rings an alarm.

The float is weighted down just enough to overcome the buoyancy of the oil and to float in water, the water being heavier than oil. The amount of weight necessary to adjust the float is determined by experiment.

To insure perfect contact, and to guard against the ignition of gas which may accumulate over the oil tank, making and breaking of the electric alarm circuit is done

in a fiber cup. In the bottom of the cup is a small amount of mercury in contact with one electrode, the other being a movable weight in the fiber cup counterbalanced on the end of a lever which is mounted on a knife-edge support.

The mercury is covered with oil to prevent sparking when the electric circuit is closed or opened. There is also a small fiber insulator on the end of the float rod to prevent sparking when the float rod comes in contact with the lever which operates the contact maker. This is necessary in the event of grounds developing in the electric circuit.

The small stop between the knife-edge support and the end of the lever adjacent to the float rod holds the lever in a definite position when the weight in the fiber cup is not making contact with the mercury, the counterbalance weight being just heavy enough to hold the lever down against the stop.

The object of this device is to notify firemen of the presence of water in fuel-oil tanks, so that it may be pumped out before it accumulates enough in depth to get into the burner lines.

J. M. Long.

Redondo Beach, Calif.

Hot Feed Water Caused Pump Trouble

In reference to H. C. Wight's trouble with hot feed water, mentioned in the issue of Mar. 10, I do not see why it was necessary to remove a shelf from the heater, or to pass a part of the exhaust steam to the atmosphere.

All the changes needed in such a case would be to put a tee in the suction line, close to the pump, and connect a pipe about 10 ft. high to act as a vapor column. Then the pressure would be equalized and the feed water could be heated up to about the boiling point.

Andrew Yorke.

Hosmer, B. C., Canada.

Lubricating Engine Bearings*

For bearings having a moderately high speed, with the oil fed into the bearing under perssure, the most satisfactory method of distribution is to run a straight groove to within a short distance of each end of the bearing. The pressure and revolving shaft will then keep up the continuous film. On heavy reciprocating sets having necks 20x36 in., with four-part bearing, I doubt if Mr. Farnsworth can find one that is not grooved.

In a slow-speed reciprocating engine the oil grooves act not only as distributers but as small feed reservoirs. Grooves have another good point, they catch and hold dirt which would cause cutting. Crankpins, if they receive a continuous supply of oil are not hard to lubricate as the action of the pin under fair pressure tends to help distribute the oil due to centrifugal force.

There are bearings, however, which will surely give trouble if they are not grooved, a case in point being a De Laval single-stage turbine wheel with drop lubricators.

I am not quite clear upon one passage in Mr. Farnsworth's letter, "100-lb. bearing pressure." Does he mean the weight of the shaft and wheel referred to the bearing area or the combined weight when loaded? If the latter, I must say that I have never yet found one having such liberal bearing surface. The bearing often neglected is the crosshead pin, which should undoubtedly be fitted with a self-feeding grease cup.

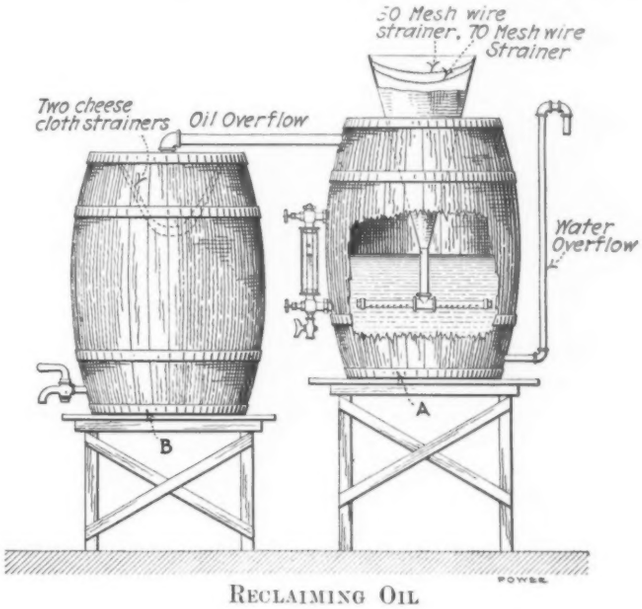
E. R. Pearce.

Rochdale, England.

*See "Power," Jan. 20, 1914, page 104, and Apr. 7, page 493.

Oil Reclaiming and Filtering

The sketch shows a method that I have used to reclaim and filter waste oil. The barrel *A* is used as a separator and *B* as a strainer and receptacle. A ½-in. pipe is



Reclaiming Oil

screwed into the barrel near the bottom, and fitted up so that the upper end is as high as the top. It is inclined enough for the water to overflow while the oil is overflowing into barrel *B*. A funnel into which the oil is emptied is soldered to a ¾-in. pipe, which extends nearly to the bottom of the barrel, and is fitted with a perforated pipe, as shown. The funnel has a 50- and 70-mesh wire strainer, through which the oil is poured. The barrel is kept about half filled with water. In barrel *B* a hole is cut in one head and two cheesecloth bag strainers are either made on hoops or tacked to the head, as shown.

If the water in the separator is kept near the boiling point, the oil will lose nearly all of the solid gritty substance, and the cheesecloth strainers will collect and hold anything that would injure the bearings. The oil collected is of several different grades. It is not safe to use it on a high-speed shaft, although it can be used on shafts and bearings where a high-grade oil is unnecessary.

Grover C. Hopkins.

East Pittsburgh, Penn.

Delivery of Pump Increased by Throttling the Suction

The hotwell overflow from a 150-hp. engine at one time discharged through about 50 ft. of 4-in. cast-iron piping to a cooling pond (or "lodge," as we call them in Lancashire), but owing to extending the building the lodge has been covered over and is now of no use for cooling purposes.

The original pipe to the lodge is still in place, but at present the water is all supposed to be delivered by a centrifugal pump to the roof, where a number of cooling troughs have been arranged. The pump delivered water intermittently for about 3 min. and then stopped altogether for about an equal period.

At the air pump it was seen that the level of water in the hotwell gradually rose and fell, the period of fluctuation corresponding with that of the discharge from the pump.

What was happening became evident. The centrifugal pump was capable of taking more water than the air pump was delivering, and consequently lowered the water in the hotwell until it drew air. For the pump to get rid of this air occupied a matter of about 3 min., during which time the water rose in the hotwell and flowed to the lodge through the old overflow pipe.

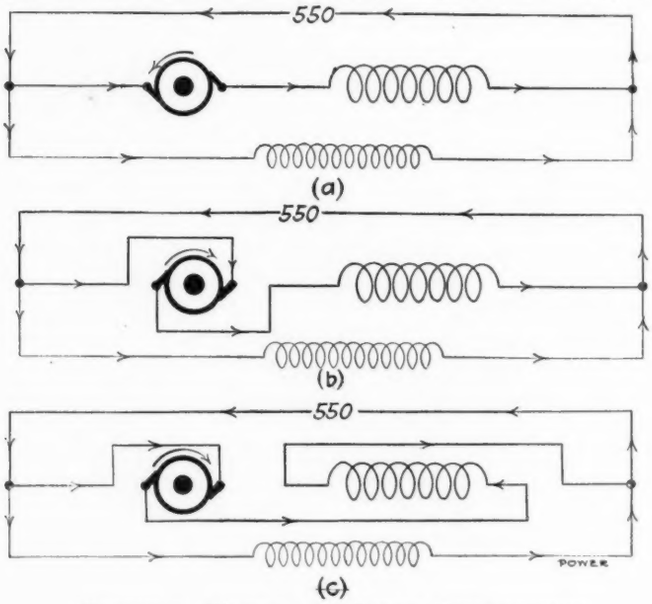
The remedy was to restrict the centrifugal pump until it just maintained a steady level of water in the hotwell. This was done by means of a valve on the suction, with the result that the pump now maintains a steady discharge and delivers about three times as much water as previously.

C. K. Williams.

Manchester, England.

Reversing Rotation of Interpole Motor

Assuming that the interpole field coils and the armature of an interpole motor have the right relative connections for a given direction of rotation, if it is desired to reverse the direction of rotation of the armature, it



Original, Wrong and Right Connections

may be done either by reversing the field or by reversing the armature and interpole field considered as a single unit. In a case in mind, the shunt-wound interpole motor as it came from the makers was connected to run in a clockwise direction. It became necessary, however, that it be run counterclockwise.

In the accompanying diagrams *a* indicates the original connection and *b* the change made by the operator to reverse the direction of rotation. He reversed the armature connections and did not reverse the connection of the interpoles. The result was to change the correct magnetic relations of the armature and interpole magnetisms so that the brushes sparked viciously at starting, although the sparking disappeared after the motor came up to speed because the motor was running comparatively light and the interpole current was not large enough to have an appreciable effect.

The further change that was made to restore the correct armature-interpole relation is shown at *c*. Here, both the armature and the interpoles have been reversed separately, because it was inconvenient to reverse them as a single unit.

J. A. Horton.

Schenectady, N. Y.

When Ignorance Is Folly

The editorial in Power, Apr. 21, headed as above, mentions a subject which should interest engineers, that of asking questions. There seems to be a general antipathy to asking questions from one another, which is not conducive to an increase of practical knowledge of the business. Why this is so is hard to explain, as more real practical experience can be gained from practical talks than in any way except from actual practice.

Hardly a difficulty arises that somebody has not met sometime or other, and by inquiring among his friends a man may nearly always find a solution.

Some engineers are loath to give information to others, which should not be. I well remember, when I was young in the business, of a chief saying to me, "Young fellow, anything you want to know, come and ask me and I will tell you, if I know it, as I do not consider this business any secret, and if I do not know I will find out for you and then it will be information for me as well as you."

I never forgot that and always told it to my own assistants and subordinates. I say here that the man in charge of a plant, whose assistants come to him for information, will be surprised to find how many little things are brought to him upon which he lacks a thorough knowledge. The practice of explaining things in detail will broaden his own experience as well.

Further, the engineer who practices answering his subordinates' questions will find himself much better fitted to answer questions fully and to the point when put to him by his superior.

Brooklyn, N. Y.

William N. Wing.

Electrifying Furnace Air

In cases where mechanical draft is used, it would seem that a much greater efficiency could be obtained, and the smoke trouble reduced, by electrifying the air before it goes into the blower. This would cause the air to become ozone; that is, each atom of oxygen would double up, as it were, and when coming in contact with the fire it would more energetically combine than does the ordinary air—would act something like air highly charged with oxygen. Ozonizers are commercial apparatus, they do not use up much power, and their application in this case would not require a great deal of ingenuity.

A. P. Connor.

Washington, D. C.

Inquiries of General Interest

Detecting Fracture in Stay-Bolt—How can it be ascertained whether a stay-bolt staying flat surfaces is fractured?

A. D. J.

By drilling a small hole in the end of the stay-bolt a fracture will be revealed by the escape of water and steam.

Object of Condenser—How does a condenser increase the power which an engine can develop?

C. F.

By removing back pressure and thereby increasing the mean effective pressure acting on the piston.

Rate of Heat Transmission in Heaters—What is the rate of transmission of heat in tubes of feed-water heaters?

C. L. H.

The rate varies with the size of the tubes and the velocity of the water passing through the tubes. For 1¼-in. smooth tubes it increases rapidly from about 185 B.t.u. per sq.ft. per hour per degree difference of temperature for a velocity of about 22 ft. per min. to about 580 B.t.u. for a velocity of 115 ft. per min.

Height for Gage-Cocks—At what height should gage-cocks be placed on a horizontal return-tubular boiler?

J. B. P.

The lowest gage-cock should be not less than 2¼ in. above the highest point of the upper row of tubes when the boiler is set, and on a power boiler having a water glass, there should be three or more gage-cocks within the range of the visible length of the water glass.

Pulsation of Steam Pipe—How can pulsations in a steam line to an engine be prevented?

A. H. S.

By placing a receiver in the line near the engine. It should be large enough to prevent the intermittent discharges of steam to the engine from materially affecting the uniformity of the receiver pressure when sustained by a practically uniform rate of flow in the steam pipe.

Operation of Scum Blowoff—What is the best way to operate a funnel-mouthed surface blowoff, which is placed near the rear head in a return-tubular boiler?

W. D.

The best method is to open the blowoff for a few seconds at intervals of 15 to 20 min. or oftener, rather than to open it for a longer period at longer intervals. Observation of the character of the discharge is the only guide for determining the frequency of blowing off.

Acetylene Gas for Internal-Combustion Engines—Has acetylene gas been successfully employed for running internal-combustion engines in place of gasoline, and if so how does its use compare in cost with that of gasoline?

H. S.

Employment of acetylene for internal-combustion engines has hardly advanced beyond experiment, the leading obstacles to its adaptation in place of gasoline being that it cannot be used in engines employing high compression as spontaneous combustion takes place at much lower pressures, and its use is attended by a disagreeable odor. For the same power output the cost of acetylene is about 2½ times that of gasoline.

Clearance Affected by Keying Rod—What effect has keying up a solid-end connecting-rod on clearance in the cylinder of an engine?

H. G.

When the keying tends to lengthen the distance from the center of the crosshead pin to the center of the crankpin, the clearance will be increased on the crank end and decreased on the head end of the cylinder; and when it tends to shorten the aforementioned distance the clearance will be increased on the head end and decreased on the crank end of the cylinder. In some forms of connecting-rods the keying is so arranged that the wedging action of keying at one end tends to shorten and that of the other end to lengthen the distance between centers, so that keying one end counteracts the effect which the other has on the clearance.

Head Pumped Against—If water from a surface condenser carrying 23.5 vacuum is delivered by gravity with a drop of 3 ft. to a centrifugal pump which discharges at an elevation of 22 ft., what is the equivalent head which the pump works against?

F. C.

The head pumped against would consist of the net head of water plus the head equivalent to the difference between the pressure in the condenser and the pressure of the atmosphere. The net head of water being

$$22 - 3 = 19 \text{ ft.},$$

or

$$19 \times 0.433 = 8.227 \text{ lb. per sq.in.};$$

and as 23.5 in. of vacuum on the condenser signifies that the amount which atmospheric pressure is above the pressure of the condenser is

$$23.5 \times 0.491 \text{ or } 11.539 \text{ lb. per sq.in.},$$

the total pressure pumped against is, therefore,

$$8.227 + 11.593 = 19.766 \text{ lb. per sq.in., which is equivalent to}$$

$$19.766 \times 2.309 \text{ or } 45.6 \text{ ft. head.}$$

Water Evaporated with Overload—With the temperature of the feed water 150 deg. F., how many pounds of water would be evaporated per hour into steam at 100 lb. pressure by a 600-hp. boiler overloaded 25 per cent.?

T. F. C.

To raise one pound of water from 32 deg. F. to steam at 100-lb. boiler pressure would require 1188.8 B.t.u., and as a pound of feed water at 150 deg. F. would contain about

$$150 - 32 = 118 \text{ B.t.u. above 32 deg. F.}$$

then each pound of feed water at 150 deg F. raised into steam at 100 lb. boiler pressure would require about

$$1188.8 - 118 = 1070.8 \text{ B.t.u.}$$

A boiler horsepower is equivalent to the evaporation of 34½ lb. of water per hour from and at 212 deg. F., requiring 33,479 B.t.u., and 600 boiler horsepower would be equivalent to

$$33{,}479 \times 600 = 20{,}087{,}400 \text{ Btu. per hr.}$$

Since each pound of water, under the conditions stated, would receive 1070.8 B.t.u. then 600 boiler horsepower would require the evaporation of

$$\frac{20{,}087{,}400}{1070.8} = 18{,}759 \text{ lb.}$$

of water per hour, and with 25 per cent. overload the evaporation should be

$$18{,}759 \times 1.25 = 23{,}448.75 \text{ lb.}$$

of water per hour.

Relative Loss of Pressure Using 2-In. or 3-In. Supply Pipe—The supply to a hot-water tank is to be taken from an open house tank 175 ft. above the hot-water tank by a 2-in. supply line. What will be the pressure in the hot-water tank, and what will be the relative loss of pressure if the size of the supply is made 3 in. instead of 2 in.?

M. S.

The static or standing pressure would be

$$175 \times 0.433 = 75.8 \text{ lb. per sq.in.}$$

with any size of supply pipe, but when water is drawn from the hot-water tank the pressure will be reduced lower the smaller the supply pipe, because more of the pressure from the house tank will be spent in overcoming friction in the supply pipe. The loss by friction in any case will depend on the length of the pipe, the number of elbows and fittings and their roughness. These conditions being the same, the loss of pressure varies as the square of the velocity of the discharge The discharges for the same velocity would be in the ratio of $2^2:3^2$, or as 4 to 9, hence for the same discharge the velocity in the 3-in pipe would be $^4/_9$ the velocity required in the 2-in pipe, and as the loss of pressure would be practically in proportion to the squares of the velocities, then delivering the same quantity per second

$$\frac{\text{loss in 2-in. pipe}}{\text{loss in 3-in. pipe}} = \frac{1^2}{(\frac{4}{9})^2} = \frac{1}{\frac{16}{81}}$$

or about one-fifth as much pressure will be lost in pipe friction when using a 3-in. pipe as when using a 2-in. pipe.

Engineers' Study Course

Elementary Mechanics--XIII

LAST LESSON'S ANSWERS

51. In this case the distance A (see Fig. 45) is 3 in.; the distance B is 48 in., and the effort P is 75 lb. Therefore,

$$W = \frac{P \times B}{A} = \frac{75 \times 48}{3} = 1200\ lb.$$

52. The wheelbarrow is a lever of the second class;

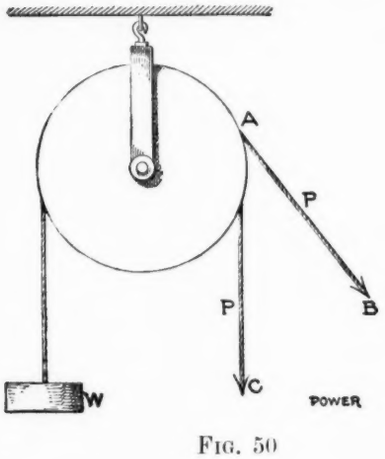


FIG. 50

hence in Fig. 46 the distance A is 12 in., the distance B is $(40 + 12) = 52$ in., and the effort $P = 60$ lb. Hence,

$$W = \frac{P \times B}{A} = \frac{60 \times 52}{12} = 260\ lb.$$

which would be the load that could be balanced by an effort of 60 lb.

53. The pressure of the wheel on the ground would be the reaction R of the fulcrum as shown in Fig. 46, or $R = (W - P) = (260 - 60) = 200$ lb.

54. The total pressure of the steam on the valve equals

$$0.7854 \times 4^2 \times 80 = 1005 \text{ lb.}$$

The distance L may be found from equation 18, thus,

$$w \times C + w_1 \times l + W \times L = P \times C$$

where $w = 10$ lb., $C = 4\frac{1}{2}$ in., $w_1 = 25$ lb., $l = 15$ in., $W = 100$ lb. and $P = 1005$ lb. Hence,

$$W \times L = P \times C - w \times C - w_1 \times l$$

or

$$L = \frac{P \times C - w \times C - w_1 \times l}{W}$$

$$= \frac{1005 \times 4.5 - 10 \times 4.5 - 25 \times 15}{100} = 41\ in.$$

therefore, to balance the steam pressure of 80 lb. per sq. in., the ball W weighing 100 lb. would be placed 41 in. from the fulcrum A.

55. Equation (19) may be used in the solution of this problem. Thus,

$$P = \frac{W \times R}{L}$$

or

$$W = \frac{P \times L}{R} = \frac{80 \times 18}{3} = 480\ lb.$$

It might be well to note at this point that the force of 80 lb. would not raise the weight of 480 lb. until the weight was set in motion by a force sufficient to overcome its inertia.

PULLEYS

The *pulley* is a machine operated by a flexible cord passing over a *grooved wheel,* which is mounted in a frame called the *block.* Pulleys are either *fixed* or *movable,* depending upon whether they are held in a fixed position or move with the given load. In this discussion, both the weight of the pulley and of the rope will be neglected as these are usually very small compared with the loads handled. Further, the friction at the bearings will be neglected, and it will be assumed that *the pull in a flexible cord or rope is uniform throughout its entire length.*

There are three systems of pulleys, but only the one in common use around the power plant will be discussed. A single fixed pulley has no mechanical advantage and can only change the direction of the pull on a given weight. Thus in Fig. 50, the effort P and the weight W are equal and this relation holds true irrespective of whether the pull P is vertical as shown by the line AC, or inclined as shown by the line AB.

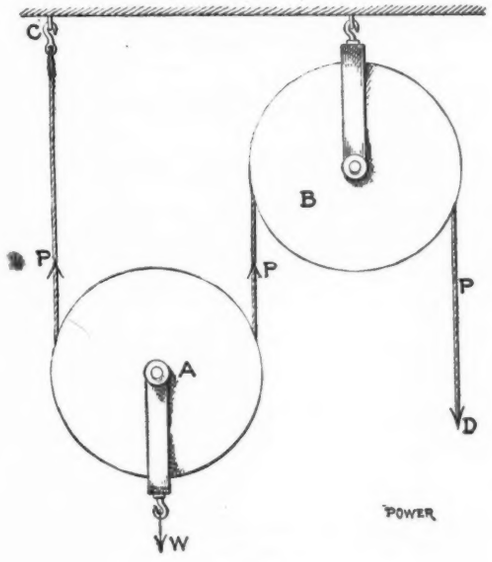


FIG. 51.

A single movable pulley A and a fixed pulley B may be used to considerable advantage. In Fig. 51, the rope is attached at the point C, passes over the movable pulley A and thence over the fixed pulley B to a point where the pull P is applied. The tension throughout the entire rope is P pounds. Therefore, the total upward pull on the pulley A is $2P$ pounds, and for equilibrium $2P$ must

equal W or $P = \frac{W}{2}$, which means that a force of 50 lb. applied at the point D is capable of balancing a force of 100 lb. at the point A.

When a pulley is made up of a number of wheels mounted on a common axis, each wheel is called a "*sheave.*" Usually, there will be one movable block and one fixed block, each consisting of the same number of sheaves. A continuous rope passes over all the sheaves as shown in Fig. 52. The rope is secured to the bottom of the fixed pulley, from where it passes to the first sheave on the movable block, thence to the fixed pulley and so alternates until it finally leaves the last sheave on the fixed pulley, and is conducted to the point where the effort P is applied. Thus, if there are three sheaves in the movable block, the total upward pull on the block will equal $6 \times P$, since the pull in the rope is assumed uniform throughout its entire length, and there are six ropes supporting the movable block.

Hence the total upward pull on the movable block in a system of pulleys of this kind will equal the number of ropes attached to, or passing over the movable block, times the effort P on the rope. If one end of the rope is attached to the movable block, the latter will contain one less sheave than the fixed block and the mechanical advantage will be less than that of the system shown in Fig. 52.

Another practical application of the principle of moments is in the *Weston Differential Pulley,* which consists of a fixed block containing two groved sheaves of slightly different diameters, and a single movable pulley which is also grooved so as to receive the links of a chain which passes around the sheaves as shown in Fig. 53. Any motion of the chain causes a positive motion of the sheaves as there can be no slipping of the chain on the sheaves. The relation between the effort P and the weight W may be determined as follows. In Fig. 53, let r be the radius of the smaller sheave on the fixed block and R_1 the radius of the larger sheave on the fixed block. Let P be the effort applied to the hoisting chain and W the weight to be balanced. It is evident that the pull in the chain passing over the movable sheave is $\frac{1}{2}W$ since there are practically two chains supporting the given weight. For equilibrium to exist, the algebraic sum of the moments of all the forces about the point O (which is the center of the fixed block) must equal zero. Thus,

$$P \times R + \tfrac{1}{2}W \times r - \tfrac{1}{2}W \times R = O$$

or

$$\tfrac{1}{2}W \times (R - r) = P \times R$$

hence,

$$W = 2P \times \frac{R}{(R - r)} \qquad (20)$$

The *mechanical advantage* of the differential pulley is

$$\frac{2R}{(R - r)}$$

By making R and r as near equal as possible, the weight W may be much greater than the effort P. The efficiency of this hoist and the relative distances moved by the weight and the effort will be discussed fully under the lesson on work and power which will come later in the course.

Study Questions

56. In Fig. 51, what weight W could be balanced by a man who exerts a pull of 80 lb. at the point D?

57. In a system of pulleys arranged as in Fig. 52, there are four sheaves on the movable block. If one end of the rope be attached to the fixed block, what weight W could be balanced by an effort of 100 lb. being applied at the free end of the rope?

58. In problem 57, assume the rope attached to the movable block. How many sheaves would be on the fixed block if there are four on the movable block? What weight W might be balanced by an effort of 100 lb. being applied at the free end of the rope?

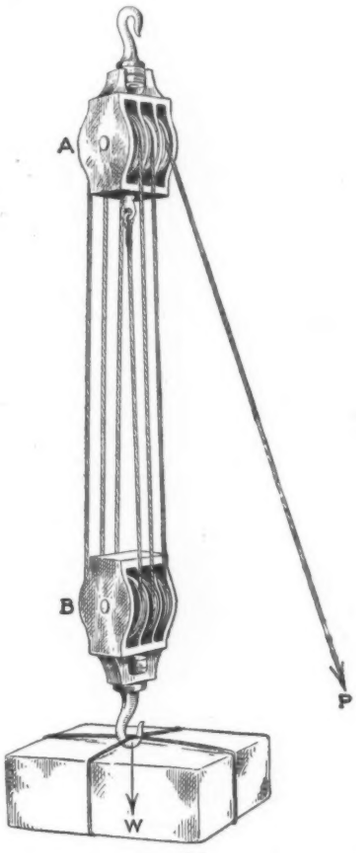


Fig. 52.

Fig. 53.

59. In problems 57 and 58 find the reactions on the hook supporting the fixed block.

60. In Fig. 53 if $R = 8$ in., $r = 7$ in., find the weight W that could be balanced by an effort of 100 lb. applied to the chain.

Electricity for Heat, and for all other services involving the use of energy, will be used in a new high school building at Rupert, Idaho, in the center of the Minidoka Irrigation Project. For the general heating apparatus, the common arrangement of hot-air pipes, etc., has been adhered to but the heat is furnished by a battery of electrical units, similar to those used in large ovens. Twenty 18-kw. units are to be installed in pairs, each pair having a separate control from a switchboard in the principal office. Current comes from the Project power house, 14 miles away, and the estimated cost of operation is placed at $1760 a year compared with coal supply at $1000 plus a fireman at $75 per month. The first cost of the electric system was $3000 less than the other. The equipment was planned by local electricians, with the assistance of the government engineers on the Project. In addition to the heating, a 10-hp. motor drives a ventilating fan and supplies power for the manual training department. An electric hot-water heater supplies the domestic science department, the shower baths, lavatories, etc. In the domestic science laboratory are individual electric stoves, an electric range, and various appliances. The electric lighting includes a small theater equipment for the school auditorium.

Baltimore Convention of the A. O. S. E.

The twenty-eighth annual convention of the American Order of Steam Engineers was held at Baltimore, Md., during the week commencing June 1, with the Rennert Hotel as headquarters. The attendance of delegates was unusually large. At the several sessions of the delegates many important matters conducive to the welfare of the organization were disposed of.

The main hall of the Fourth Regiment Armory was conveniently arranged and tastefully decorated for the use of the supplymen for their mechanical display. There were upward of ninety booths, and the exhibit attracted a good attendance throughout the week.

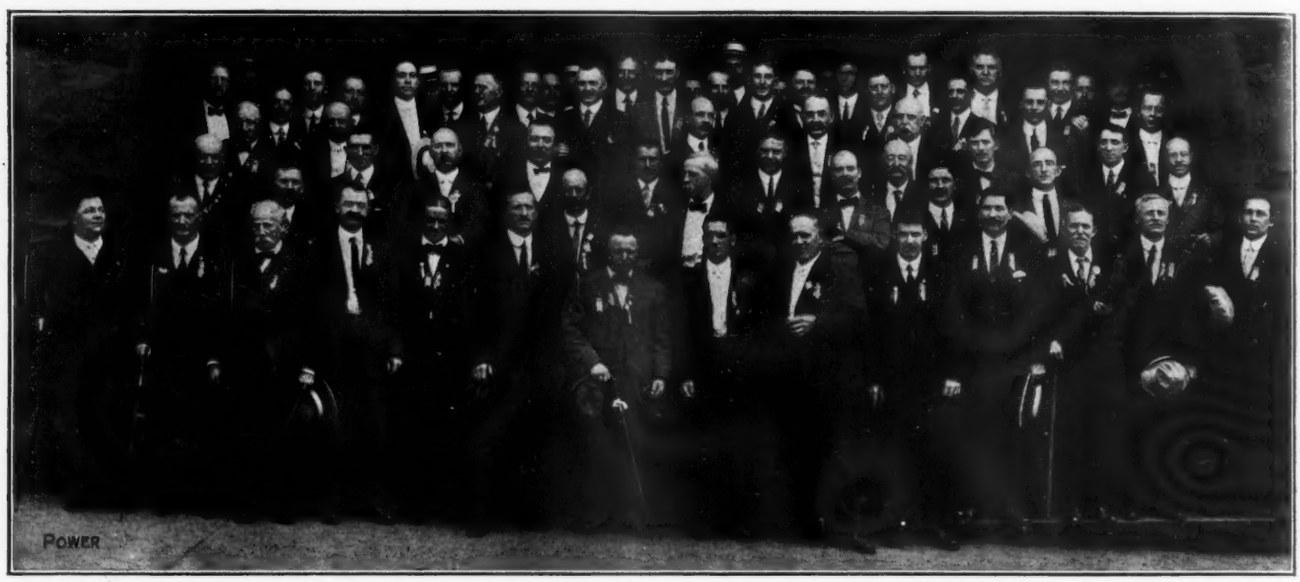
On Monday evening there was a combined gathering of the delegates and supplymen in the armory, when the formal opening of the exhibit took place. Mayor James H. Preston extended a warm welcome to the visitors, and was ably responded to by William Le Compte, past president of the Supplymen's Association. President George W. Goodwin, of the Engineers, and President Fred L. Jahn of the Supplymen, also made appropriate addresses.

At one o'clock on Tuesday the company boarded special cars for an inspection of the sewage-disposal plant. Later in the afternoon at Liberty Park there was a crab feast, followed by a ball game between the Engineers and the Supplymen which resulted in a tie after a most interesting and exciting game. The supplymen gave an enjoyable entertainment at the exhibit hall on Wednesday evening.

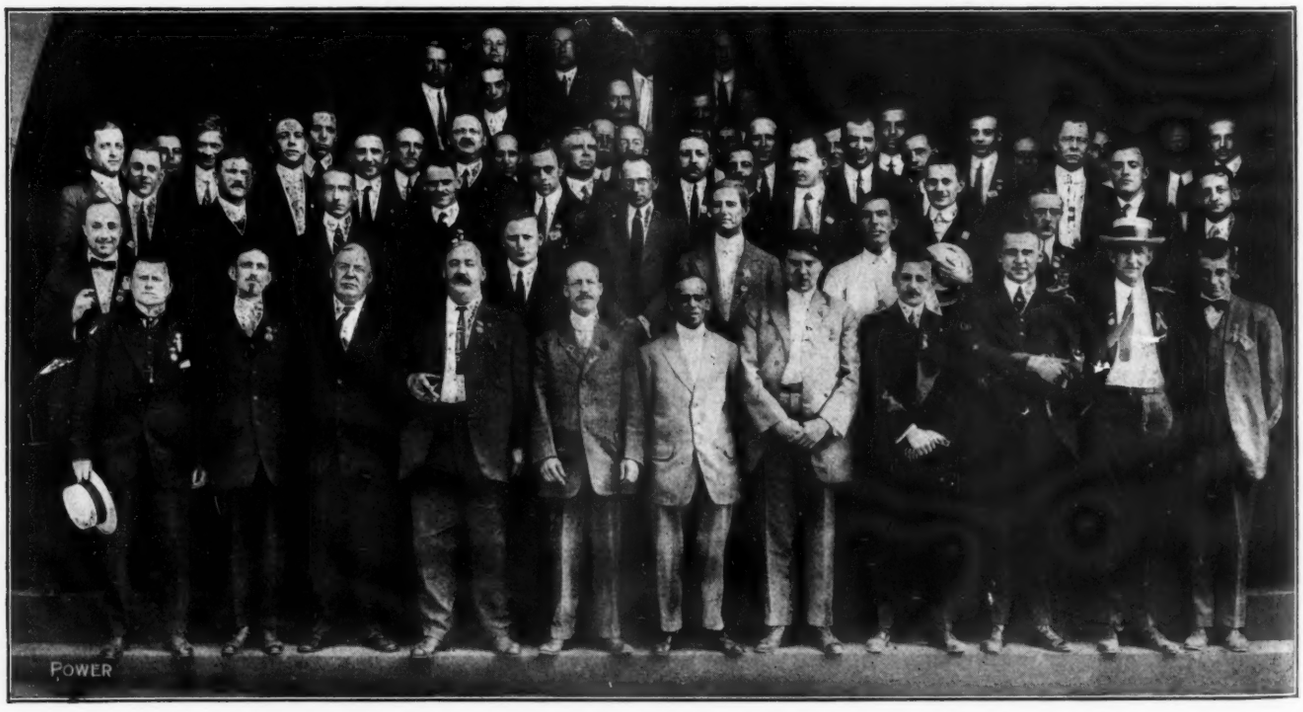
The feature of the entertainment program was the steamboat ride on Thursday afternoon. The fireboat practice given by the crew of the tug "Deluge" was greatly enjoyed and, altogether, the day was a most pleasant one.

The election of officers for the supreme council resulted as follows:

J. William Pairent, chief; William R. Smith, first assistant chief; William A. Harding, recording engineer; Edward A. Reboul, corresponding engineer; Michael Helmstreit, Jr.,



DELEGATES AT THE CONVENTION OF THE AMERICAN ORDER OF STEAM ENGINEERS, BALTIMORE, MD., JUNE 1, 1914



A GROUP OF THE SUPPLY MEN AT THE A. O. S. E. BALTIMORE CONVENTION

treasurer engineer; J. H. Moudy, senior master mechanic; H. R. Dixon, junior master mechanic; H. R. Messer, inside sentinel; William Tyson, outside sentinel; L. J. C. Callaway, chaplain; L. G. Schiehner, trustee; D. B. Heilman, trustee; G. W. Goodwin, trustee. The executive committee are George R. Richardson, Clifford P. Williams and Franklin R. Moore.

The Supplymen's Association connected with the American Order of Steam Engineers elected the following officers: Harry E. Souder, president; Charles A. Wilhoft, vice-president; Hart Hill, secretary; John W. Armour, treasurer.

A. E. Smith was appointed director of exhibits.

THE EXHIBITORS

John B. Adt Co.
Albany Lubricating Co.
American Bitumastic Enamel Co.
Anchor Packing Co.
V. D. Anderson Co.
Ashton Valve Co.
Aumen Machinery Co.
Automatic Shaft Coupling Co.
Baltimore Belting Co.
Baltimore Electrical Co.
Baltimore Gas Light Co.
Baltimore Roofing & Asbestos Co.
Cyrus Borgener & Co.
Carey Machinery & Supply Co.
Lawford & McKim
Lee Electric Co.
John R. Livezey
Geo. W. Lord Co.
The Lunkenheimer Co.
Lutz Webster Engineering Co.
McLeod & Henry Co.
Robert McMeckan & Son
Maryland Casualty Co.
Maryland Council No. 1 A. O. S. E.
Morehead Mfg. Co.
National Flue Cleaner Co.
National Tube Co.
New York Belting & Packing Co.
Crane Co.
Crook, Kriess & Co.
Cumberland Coal Co.
Dearborn Chemical Co.
Diamond Power Specialty Co.
R. & J. Dick, Ltd.
Jos. Dixon Crucible Co.
Emerson & Morgan Co.
Engineering Supply Co.
Fairbanks Co.
France Metallic Packing Co.
Frick Co.
Frick Grate Bar Co.
Garlock Packing Co.
General Electric Co.
Gray Engineering Co.
Greene, Tweed & Co.
Griscom Russell Co.
Hawley Down Draft Furnace
Home Rubber Co.
E. F. Houghton & Co.
Paul B. Huyette Co.
International Boiler Cleaning Co.
Jenkins Bros.
H. W. Johns-Manville Co.
R. Lee Jones Coal Co.
T. P. Kelly & Co., Inc.
Keystone Lubricating Co.
Lagonda Mfg. Co.
Otis Elevator Co.
Peerless Rubber Mfg. Co.
Philadelphia Bourse
Philadelphia Grease Mfg. Co.
"Popular Engineer."
"Power."
Pratt & Cady Co.
Quaker City Rubber Co.
Reeves Cubberly Gasoline Engine Co.
Wm. C. Robinson Co.
E. J. Rooksby & Co.
Frank R. Small.
L. Sonneborn Sons, Inc.
Southern Electric Co.
Standard Electric & Elevator Co.
Wallace Stebbins & Son.
Strong, Carlisle & Hammond Co.
The Texas Co.
Geo. W. Walther & Co.
Wallace & Gale.
Watson & McDaniel Co.
Warren Webster & Co.
Wilson Maltman Electric Co.
Thos. C. Worley & Co.
Chas. Zies & Son.

The 1915 convention will be held in Atlantic City.

Annual Meeting of National Electric Light Association

With an attendance of approximately thirty-five hundred, the thirty-seventh convention of the National Electric Light Association at Philadelphia, June 1 to 5, proved one of the most successful in the history of the association. Much credit is due the Philadelphia Electric Co. for the way in which the local features of the program were carried out.

As customary, the first day was devoted to the registration of members, and in the evening a reception was held at the Bellevue-Stratford, the convention headquarters. The first general session was opened on Tuesday morning with an address by Mayor Blankenburg, of Philadelphia, who took as his theme "Light as a Factor in Civilization," pointing out how it not only added to the comforts of mankind, but was also a potent aid to police power.

PRESIDENT'S ADDRESS

Following the mayor, President McCall referred to the growth of the association, and stated that its membership now numbered over thirteen thousand. He also briefly reviewed the work of the various committees and touched upon the suggestion that a modification be made in the method of conducting the national convention, confining the meeting to a few representatives from geographical sections, these delegates to give consideration to broad policies only. The commercial and technical details would then be taken up by the state conventions. "Much might be said in favor of this change of policy," commented Mr. McCall, "and the change would no doubt be welcomed by those whose duty it has been to prepare for the holding of national conventions." No definite action was taken upon the suggestion, however.

As to governmental regulation, President McCall expressed the opinion that public-service commissions, which have now been established in a majority of the states, have led to a better understanding of the relations between the public and the utility companies. These commissions have, in general, wisely used the powers intrusted to them, and they have protected both the community and the company from hasty and ill-advised action which is often the outcome of political pressure.

SECRETARY'S REPORT

The secretary's report dealt principally with the work being carried out at the executive offices in New York, and with the publications of the association. This was followed by the report of the insurance expert, W. H. Blood, who spoke of the proposed revision of the National Electrical Code, with regard to constant potential pole lines of over 5000 volts and to refillable fuses.

REPORT ON PROGRESS

T. C. Martin's report on progress dealt with the general conditions of the electrical industry and was so full of interest and instructive statistics, that a rather obvious attempt to discredit the municipal plant may be passed over without further comment. Quoting from the recently published figures of the United States Census Bureau, it showed that there was in 1912 installed in central stations in this country about 5,000,000 hp. in steam turbines and steam engines, and 2,500,000 hp. in waterwheels; these figures are now exceeded. During the past year the Commonwealth Edison Co., of Chicago, showed a gain of nearly 19 per cent. in its output over that of the preceding year; the Philadelphia Electric Co., 25 per cent.; the New York, Boston and Brooklyn Edison companies, each about 11 per cent.; and the Niagara Falls Power Co. a gain of 9 per cent.

Relative to the pending national legislation regarding holding companies, Mr. Martin was of the opinion that whatever the objections to holding companies with reference to the control of competing interstate railroads or industrial enterprises, they can have little, if any, application to the electric-lighting or electric-railway field. "Such bodies, in the electrical field," he said, "are not organized to stifle competition, but to give the benefit of expert aid in engineering and finance to scattered parts, whose existence otherwise often would not be warranted." Statistics were quoted to show that out of 4774 plants in towns of over 1000 population, 29 per cent. have syndicate affiliations, 48 per cent. are independent, and 23 per cent. are municipal.

During the past year public-service commissions were created in ten more states, including Illinois and Pennsylvania; the principal provisions of the public-service laws in these two states being cited.

The secretary's report also gave a complete description of the new 201st St. station of the United Electric Co. in New York.

Touching upon hydro-electric progress, space was devoted to a review of the work and recommendations of the conservation congress held in Washington last December. While a number of hydro-electric plants were completed and put in operation in this country during the past year, no radical departures from previous practice were noted. Descriptions of several of these plants were contained in the report and attention was called to the increasing use of outdoor substations. In Europe, however, several important developments have been projected, notably two plants on the upper Rhone, one of 150,000 hp. and the other of 120,000 hp. These will transmit electricity to Paris at 150,000 volts. Also, the Italian Parliament has recently passed an act authorizing the construction of a 150,000-hp. hydro-electric development at Calabria, in southern Italy.

TECHNICAL SESSIONS

At the first technical session the committee on meters rendered its report, which was followed by that of the committee on grounding secondaries. This showed that many of the smaller companies are not paying as much attention to grounding secondaries as they should; that many are grounding to driven pipes and buried cones, neither of which methods is allowed by the code. The report emphasized the importance of grounding to water pipes, and pointed out that this is not detrimental to the piping.

Reporting on "electrical measurements," Dr. A. E. Ken-

nelly gave a brief outline of the course of events which led to the adoption of an international standard of electrical conductivity for copper by the International Electrotechnical Commission in Berlin last September.

Dr. C. P. Steinmetz was most optimistic as to the future for the electrical vehicle in that it would be a means to greatly improving the central-station load factor. Citing the history of the bicycle, he predicted that during the next ten years the automobile would have run its course as a vehicle of pleasure and would be used almost exclusively for business. In this capacity the demand would be for moderate speeds and simplicity of operation with minimum attendance. Here, he contended, the electric vehicle would come to its own, and the charging of the batteries during off-peak hours would provide a most profitable business for the central station. As these machines rarely use up the full charge during the day, he believed that the central station could ultimately take over such service at a fixed charge of, say $10 per month.

The second technical session was held Wednesday morning, the first report being that of the committee on electrical apparatus, which was presented by L. L. Elden. The more recent types of converting and generating apparatus, air-cooling devices, switchboard equipment and protective devices were taken up, and reference was made to the use of synchronous condensers for voltage regulation of high-tension lines.

"Temperature and Its Effects on the Power Capacity of Electrical Apparatus"* was the subject of a most interesting paper by F. D. Newbury. This presented the information at present available on the heat and temperature conditions within large alternating-current generators, the safe temperature limits of the various insulating materials in common use, and the significance of temperature measurements by different methods.

Underground construction was treated by the committee of which Philip Torchio was chairman. Operating data on high-tension cables were submitted by member companies, a marked difference being shown in the thickness of insulation used for cables of relatively low voltages, but greater uniformity for high-voltage cables. The maximum allowable loading from different companies gave temperatures varying from 90 to 150 degrees Fahrenheit for the lead sheath, and tests made to supplement this information showed the temperature of the conductor to be as much as 75 degrees higher than that of the sheath. The committee stated that its efforts to discover an inexpensive system of underground distribution had been futile.

The report on overhead line construction was next presented by Thomas Sproule, of Philadelphia, and completed the program of that session.

PUBLIC POLICY

Mr. Insull, in reporting for the public policy committee, expressed much the same views as did President McCall regarding public-service commissions, but further voiced the seriousness of any contemplated national legislation designed to limit the activities of generating companies. In this connection, he urged that missionary work be done in educating congressmen and senators on the economics of the business as a natural but regulated monopoly, so that there would be no tendency to check electrical interstate business through misdirected anti-trust legislation. Commenting on prosperity, he declared that hard times did not seem to affect the electrical business, which was attributable to the electrical companies not yet having developed their territories to the saturation point.

ANNIVERSARY EXERCISES

After Mr. Insull's remarks the Wednesday evening meeting was devoted to exercises celebrating the 30th anniversary of the First International Electrical Conference and Exhibition held at Philadelphia in 1884. Walton Clark, president of the Franklin Institute, presided and introduced as speakers a number of pioneers in the electrical industry, including Dr. Charles F. Brush, inventor of the arc-lighting system, F. J. Sprague, of electric-railway fame, and E. W. Rice, president of the General Electric Co. Thomas Edison was also present, but following his usual custom, did not make an address.

Mr. Rice spoke of having attended the Philadelphia conference, as a young man, and listened to such distinguished scientists as Kelvin, Preece, Thomson, Newcomb and Rowland. In 1884, he said, not a single trolley car was in existence, the highest potential employed was 2000 volts and the largest electrical generator was the Edison "Jumbo" machine, having a rating of 1200 sixteen-candlepower lamps. The electric motor was just coming into use and a few of small size were exhibited; the largest engine on exhibition was of less than 150 hp.

Dr. Brush, after relating some reminiscences of his early experiences in electric lighting, told of the first installation in Philadelphia, that of Wanamaker's store, which contained 20 arc lamps. One year later, 1879, the first electric street lights were placed in the public square at Cleveland.

Mr. Sprague spoke of his work in connection with the building of the first electric street-car line, in Richmond, Va., in 1887; also the electrification of the elevated railways in New York. He predicted the electrification of trunk-line railways, stating that this would be brought about by the greater centralization of power generation, the railroads finding it cheaper to purchase electricity from such sources than to generate it themselves.

THIRD TECHNICAL SESSION

The report on prime movers was divided into two sections, that on steam being presented by J. B. Klumpp, in the absence of Chairman I. E. Moultrop, and that on hydraulic matters by J. F. Vaughan.

Under the steam heading the following subjects were discussed: Cost of Steam Power Standby Service, Forced Draft for Peak Work, Emission of Smoke and Cinders, Burning Pulverized Coal, Under-Water Storage of Coal, Firebrick, Steam-Flow Meters, Surface Combustion, Condensers, Boiler Tubes, and Foreign Practice.

Under the first heading was described the practice at the Ashley Street station in St. Louis,* where the standby boilers are kept full of hot water at over 200 degrees by means of a hot-water circulating system. The amount of coal used for banking is about 5 per cent. of the total consumption of the station.

With regard to cinders, the report stated that there is practically no trouble from this source with natural draft, or where the difference in pressure through the fire is 1 in. or less. With forced draft, however, there is frequently a noticeable shower of cinders in the vicinity of the plant, particularly where coking coal is used. The best solution of this problem has been worked out by the New York Edison Co., in causing the gas to impinge against a wet baffle plate, from which it is deflected downward toward a trough of water, in which the cinders are caught.†

The committee did not consider under-water storage of coal as warranted generally, owing to the high cost of such storage as compared with the low insurance rate and the fact that well selected coal was fairly secure against taking fire. If it did, the pile would give a long warning of the tendency to heat.

Lap-welded charcoal-iron boiler tubes were formerly demanded by most steam users because they were not so likely to corrode as steel. Genuine charcoal iron, however, has become very scarce, and the demand for tubes has greatly increased; hence it is difficult to obtain the quality of tube desired. All tubes other than seamless must be welded, and, as in all welds there is a chance for imperfect workmanship, the open-hearth seamless steel tube is now being specified largely and is used with much success.

HYDRO-ELECTRIC SECTION

The papers presented on this subject were: "The Nature of Electrical Disturbances in Transmission Work," by D. B. Rushmore; "Data on Modern High-Voltage Transmission," by Selby Haar; and "Water-Power Plant Economics," by O. B. Coldwell. These were followed by an illustrated lecture by H. J. Lisberger on the plants and system of the Pacific Gas & Electric Co., in California.

Upon recommendation of the committee the hydroelectric section was disbanded, this work to be carried on in the future by a hydro-electric committee.

Simultaneously with the technical sessions were held the commercial and the accounting sessions. These comprised reports of the various committees in addition to the following papers: "Costs and Statistics," by T. J. Walsh; "Appraisals, by D. C. Jackson; "Variations in Public Service Systems of Accounting, by E. C. Scobell; "Accounting for Merchandise Sales," by H. B. Lohmeyer; "Suspense Accounts," by Frederick Schmitt; "Mechanical Sorting and Tabulating Systems," by F. A. Birch, G. L. Knight and C. N. Woolsey: "Purchasing, Storing and Accounting of Coal for the New York Edison Co.," by Charles R. Lehmann. Elbert Hubbard also delivered an address on "The Age of Coöperation."

Of particular interest were the concluding remarks of the committee on high load factor and nonpeak business which were in part as follows:

"There are in practically all cities several private generating plants which give as an excuse for operating, the fact that they need steam in large quantities during the winter months for heating their buildings. Although the central-

*A more complete abstract of this paper will appear in a later issue.

*See "Power," Jan. 6, 1914.

†See "Power," Jan. 27, Feb. 3, 10, 17 and 24, 1914.

station companies in these cities have made all reasonable efforts to get this business, there are many instances where, at the present time, there is a deadlock in negotiations. These same plants for the most part realize that they could operate more efficiently and economically on central-station service during the summer, but do not see their way clear to signing a long-term contract whereby they must assume certain obligations during the winter months, when they could run more economically on their own private plants.

"From the standpoint of the central station it could make money on this class of business, if taken only for the summer months as it would be distinctly off-peak.

"It would, therefore, seem a good proposition for both interests, for the central station to offer a short-term contract for summer business from existing plants.

"However, as against this, consideration must be given to the effect such a policy would have upon the other customers of the company. In other words:

"1. Would such a course indicate that the central station admits it cannot operate in large buildings economically if steam is used in any appreciable quantity for heating?

"2. Would not the present large installations, where central-station service has superseded a private plant and shown an economy, start up their own plants during the winter months and use their exhaust steam for heating?

"Consideration must also be given to another point, whether by demonstrating the superiority of central-station service during the summer months, we could obtain some of this business for the entire year which we otherwise could not get."

On Friday the third general session was held and the following officers elected for the ensuing year: President, H. H. Scott, New York; first vice-president, E. W. Lloyd, Chicago; second vice-president, H. A. Wagner, Baltimore; third vice-president, L. D. Gibbs, Boston; fourth vice-president, J. S. Bleecker, Columbus, Ga.; treasurer, W. F. Wells, Brooklyn and the executive committee to serve three years, Paul Spencer, Philadelphia; A. C. Einstein, St. Louis, and Walter Newmiller, New York.

A splendid exhibit of electrical apparatus and accessories was held in the roof garden of the Bellevue-Stratford.

ENGINEERING AFFAIRS

The National Gas Engine Association will hold its annual meeting at the La Salle Hotel, Chicago, Ill., on June 24, 25 and 26. Among the subjects to be discussed will be a standard belt speed, horsepower rating and a standard brake. The local entertainment committee has provided some wholesome entertainment, including a boat trip to Michigan City, where supper will be served, and a moonlight trip back to Chicago. Everyone interested in gas engines is invited to attend the convention.

The forty-second annual commencement of Stevens Institute of Technology, Hoboken, N. J., was held on June 9, at which 65 members of the graduating class received the degree of mechanical engineer. Henry S. Pritchett, Sc.D., LL.D., addressed the graduating class in well chosen remarks founded on the philosophy of Epictetus: "(1) Don't quarrel with the universe; (2) Touch elbows with the rank and file; (3) Live as much as you can each day in the open air, and (4) Every day speak with someone higher, wiser than yourself." The Stillman prize to the member of the senior class who prepares the best paper on a subject pertaining to technology was awarded to Hermann Henry Albers, of Brooklyn, N. Y. His subject was "Devices and Methods for Measuring High and Low Temperatures, with Special Reference to Engineering Problems."

Big Realty Building Again Operates Its Old Plant—The Metropolitan Realty Building, a fifteen story manufacturing structure, occupying a 50 by 200-ft. plot north of the Brooklyn Bridge, in New York City, will repair its old plant and make its own current. In 1892, when the building was erected, a power plant was installed to furnish heat, light and power to the tenants. After the plant had been operated for some years, the management was induced to shut it down because of repairs and other excessive costs, and buy its current. After a three-year trial of Edison service and two years more of the New York Service Co., a subsidiary concern, the management has concluded to let the Engineering Supervision Co. of New York operate the old plant under a guarantee of economy.

OVER THE SPILLWAY

JUST JESTS, JABS, JOSHES AND JUMBLES

"You must be born with wheels in your head if you would make a good engineer," says a contemporary. So that's the reason, is it? Guess we'll ask our old friend Coroner Tim Healy to order an autopsy and verify this statement. Any good engineer got a wheel to lend?

The House Appropriations Committee wants the Federal Children's Bureau budget cut from $164,640 to $25,640; free seeds (for constituents) get $165,000, and to stamp out the hog cholera, they'll let go of $400,000. Looks like the "hog" cholera had its incipiency in the House.

A high forehead says that insomnia points to the time "when man shall be able to use his cerebral engine every hour of his brief life." It would be a brief life for most of us if our brain engines attempted one of those fool 24-hour work tests. We hit the hay around eleven o'clock, and then it's good night till the morning after the night before—unless we are at a convention, when we just can't be beguiled by O'Morpheus into retiring before eleven-thirty.

Good old Fred Raven struck the keynote when, at the Illinois State convention, he wondered "if all appreciated the fact that the opportunities of the organization were only half realized." When Fred opens his mouth he says something.

"Who over here ever heard of Ding, the English aviator?" asks the New York "Sun". Why, old son, Ding is the brother of our friend By Ding, who goes up in the air so much; an uncle of Gol Ding, and second cousin to those expatriated Americans the Ding-Bustits.

Last year Berlin consumed nearly twenty billion gallons of water. Since when have the Berliners taken to drinking this stuff? Sounds like a willful waste and a woeful want of "taste."

Convention time! It toddles around regularly each year, along with the humidity, the 'skeeters and the prickly heat; sulphur and molasses can't get it out of your system once the convention rash breaks out. Its only remedy is Go-to-It!

This year the Illinois boys started the ball to rolling with a corking good convention. Then New Jersey rounded the corner, eleven associations strong, and the Master Boiler Makers woke up old Philadelphia after the manner of boiler makers; Iowa, and Kansas, and Kentucky, the big national meet of the American Order at Baltimore—

Say, son, it's in the air; just one dum thing after the other right up to the big fest at Milwaukee!

The engineer who never attended a convention—shucks, Zeke, there ain't no such thing! Every engineer goes; if not in person, he's there in spirit. And he knows his interests are being taken care of and his delegates are reflecting credit on his craft!

INSTALLING AN ISOLATED PLANT

Boston Pumping-Station Explosion

An explosion of sewer gas completely wrecked the small screenhouse at the northwest end of the Metropolitan sewage pumping station near Chelsea Bridge, East Boston, about noon on June 1, smashing windows, strewing the wreckage for 70 ft. around and causing the death of three attendants and the serious injury of several others.

The house, which was about 25 ft. square, was strongly built of brick and steel, as is evidenced by the fact that several large sections of the walls were blown some distance without breaking. The station cares for about 200,000,000 gal. of sewage per day, about one-third of the total amount for the city of Boston. Pending repairs, the sewage will be discharged through auxiliary gates without screening.

St. Paul Electric Power Rates

The assembly and the board of aldermen, in surrendering control of the affairs of the city of St. Paul to their successors under the new commission form of government, have just recommended further investigation with a view to the adoption of an ordinance reducing the electric rates now charged by the Gaslight Co.

Supporting this movement, the Builders' Exchange of the city lately sent a communication to the mayor expressing particular interest in the power rates, and asserting that manufacturers in Minneapolis enjoy more favorable rates and conditions for electric-power service. The difference is said by the Exchange to be sufficient to give Minneapolis an advantage in the location of new manufactures in the Twin Cities.

PERSONALS

A. A. Potter, for several years professor of steam and gas engineering at the Kansas State Agricultural College, has been made dean of the engineering division and director of the engineering experimenting station of the same institution. Mr. Potter will still retain the professorship in steam and gas engineering.

Harold Almert, Chicago, Ill., has been retained as technical counsel by the Washington Railway Electric Co. and the Potomac Electric Power Co., of Washington, D. C. The appraisal division of Mr. Almert's staff will make a detailed inventory and valuation of the property of these companies, not only in Washington, but throughout the District of Columbia, in preparation for a hearing before the Federal Utility Commission, which commission appeared before the local committee of Congress, through the corporation counsel, on June 2, and declared itself in favor of immediate Federal ownership of the utilities in the District of Columbia.

Richard Ward Baker has been in the employ of the Watson-Stillman Co., Aldine, N. J., and New York City, for fifty years. The company has rewarded him by the presentation of a substantial check and extending to him a month's vacation. Mr. Baker began his apprenticeship in a small factory in Grand St., New York City, on June 2, 1864, and has been continuously identified with the Watson-Stillman Co. and its predecessor ever since. A special resolution was passed by the board of directors of the company expressing its high esteem of Mr. Baker's long and loyal service, and the resolution was presented to him in the presence of the employees, officers and directors of the company at its Aldine plant.

Gano Dunn, president of the J. G. White Engineering Corporation, in recognition of accomplishments and distinction in science and electrical engineering, had the honorary degree of master of science conferred on him on May 29, at the celebration of the fiftieth anniversary of the founding of the School of Mines of Columbia, University. Mr. Dunn is president of the United Engineering Society and has been president of the American Institute of Electrical Engineers and the New York Electrical Society. He is a member of the British Institution of Electrical Engineers, the International Electrotechnical Commission, the American Society of Mechanical Engineers and other scientific and engineering bodies and was United States delegate to and vice-president of the last International Electrotechnical Congress which was held in Turin, Italy, in 1912.

Electric Drive to Speed Up Machine Shop—Speeding up a machine shop by means of an electric drive has been proved possible at a shop maintained by the city of Chicago for repair work on pumping and other apparatus for the water department. Formerly the shop was driven by a slide-valve steam engine through intricate line shafting. No-load tests made showed that 53 per cent. of the power generated was required to drive the line shafting and idle pulleys. During the year 1913 a motor-generator set was substituted for the steam engine, with the result that the line-shaft losses have been reduced from 53 to 10.8 per cent. Furthermore it has been possible to increase the speed of the line shafting a third, and the men in the shops have unconsciously speeded up correspondingly.—"Engineering Record:"

NEW EQUIPMENT

ATLANTIC COAST STATES

Plans have been prepared for the construction of a substation for the Buffalo General Electric Co., Buffalo, N. Y. The estimated cost is $20,000.

The Orange County Lighting Co., Middletown, N. Y., has had plans prepared for the construction of a new gas plant.

The citizens of Butler, N. J., contemplate installing a municipal electric-light plant costing $30,000.

A 1500-kw. turbo-generator and new boiler equipment will be installed at the plant of the Morris & Somerset Electric Co., Morristown, N. J. J. H. Drake is manager.

The Public Service Electric Co., Trenton, N. J., contemplates constructing a substation on Adeline St.

Bids will be received until noon, July 8, by the Waston Electric Light Commission, Easton, Md., for a complete power and lighting equipment. The Reliance Engineering Co., 312 Fourth National Bank Bldg., Cincinnati, Ohio, is the engineer.

Bids will be received by the supervising architect, Treasury Department, Washington, D. C., until July 8, for repairing the mechanical equipment at the United States Treasury, Winder and Butler buildings, Washington.

SOUTHERN STATES

Fire destroyed the power house of the Sampson Power Co., Clinton, N. C. Loss, $5000.

According to press reports the Savannah Lighting Co., Savannah, Ga., will remodel its power plant and substations. New equipment will be installed. The estimated cost is $200,000. The Schofield Engineering Co., Philadelphia, Penn., is the engineer-in-charge.

The installation of an electric-light plant in Camden, Tenn., is being considered by J. S. Madey & Son.

Gotthart Kapfhammer, 1506 Shelby St., Louisville, Ky., is in the market for a motor to operate special baking equipment.

CENTRAL STATES

Bids will be received by the commissioner of purchases and supplies, City Hall, Cleveland, Ohio, until noon, June 19, for furnishing and installing two 300-hp. water tube boilers for the Infirmary, Warrensville, Ohio.

Bids will be received by the commissioner of purchases and supplies, City Hall, Cleveland, Ohio, until noon, June 19, for the construction of stokers for the two 300-hp. boilers for the Infirmary, Warrensville, Ohio.

Bids will be received by the commissioner of purchases and supplies, Room 513, City Hall, Cleveland, Ohio, until noon, June 19, for the construction of stokers for two 250-hp. boilers for the City Hospital.

The Logan Light & Power Co., Logan, Ohio, which was recently bought by Arthur D. Foster and Francis R. Weller, will be enlarged. A new power house will be built and also a generating station.

According to press reports the East Jordan Light & Power Co., East Jordan, Mich., will install a tandem compound Ideal engine, a condenser, one 100-kw. Bullock generator.

According to press reports the board of managers of the Hurley Hospital, Flint, Mich., contemplates purchasing a new power plant for the hospital costing $9000.

The C. Reiss Coal Co., Waukegan, Ill., will establish a generating plant to supply power for its coal dock.

WEST OF THE MISSISSIPPI

Nash & Co., South Bend, Ind., are preparing plans for the construction of a municipal electric-light plant and pumping station at Earlville, Iowa.

The Oscar Claussen Engineering Co., 314 Commercial Bldg., St. Paul, Minn., is preparing plans for the construction of a municipal electric-light system at Parker, S. D. The estimated cost is $27,000.

Bids will be received by W. F. Baker, city clerk, Coldwater, Kan., until 1 p.m., June 25, for improving the electric-light plant and water-works. One 75-kw. generator, one 25-hp. motor and equipment and a 100-hp. oil engine will be required.

At a recent election the citizens voted to install a municipal electric-light plant at Vermillion, Kan., costing $10,000.

At a recent election in Los Angeles, Calif., bonds for $6,500,000 to complete the aqueduct power project and for a distributing system were voted.